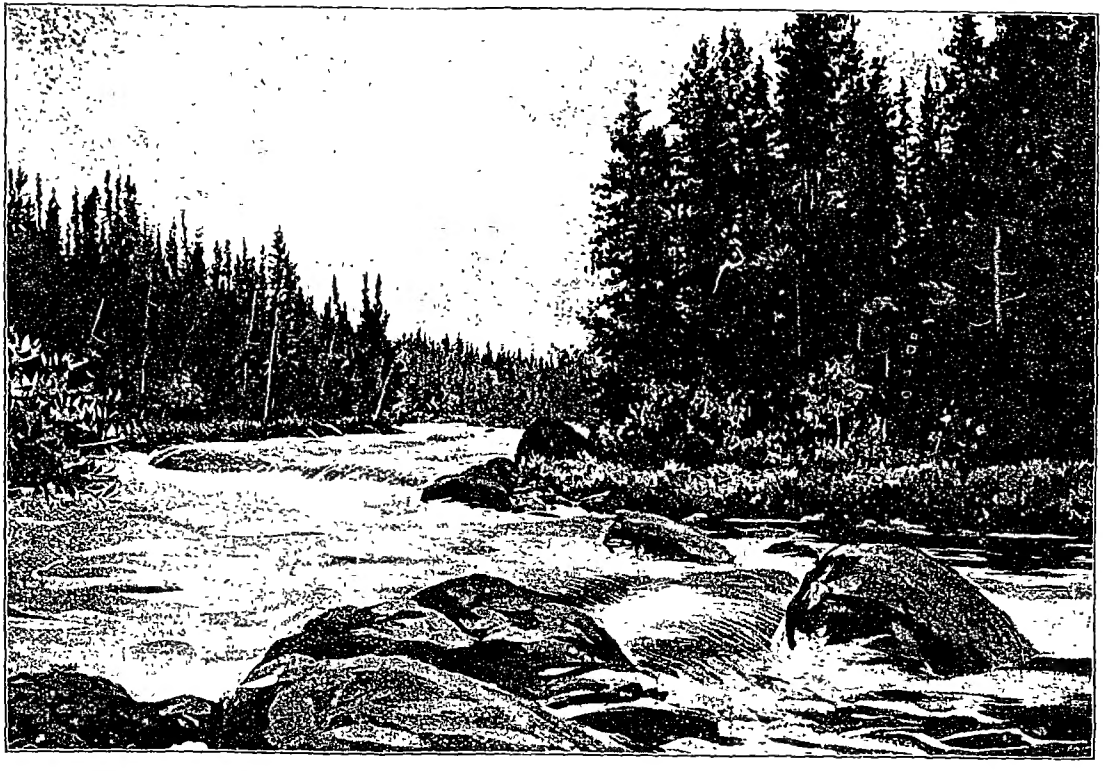


J. B. TYRRELL.—Photo., Aug. 27, 1892.

WHITE SPRUCE FALLS, GEIKIE RIVER.

Drift-covered country, North of the watershed between Stone and Churchill Rivers.

GEOLOGICAL SURVEY OF CANADA
G. M. DAWSON, C.M.G., LL.D., F.R.S., DIRECTOR

REPORT

ON THE COUNTRY BETWEEN

ATHABASCA LAKE AND CHURCHILL RIVER

WITH NOTES ON TWO ROUTES TRAVELLED BETWEEN THE CHURCHILL AND SASKATCHEWAN RIVERS

BY

J. BURR TYRRELL, M.A., F.G.S., ETC.

ASSISTED BY

D. B. DOWLING, B.A.SC.

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY
1896

GEORGE M. DAWSON, C.M.G., LL.D., F.R.S., &c.,

Director Geological Survey of Canada.

SIR,—I have the honour to present herewith a Report, accompanied by a map on the scale of twenty-five miles to one inch, on the country extending from Athabasca Lake to Churchill River, with brief descriptions of the routes followed between the Churchill and Saskatchewan rivers. The report has been somewhat delayed by my long absence during two seasons in the far north, since the completion of the work to which it relates.

I have the honour to be, sir,
Your obedient servant,

J. BURR TYRRELL.

Geological Survey Office,
19th May, 1896.

NOTE.—*The bearings given throughout this report refer to the true meridian.*

REPORT

ON THE COUNTRY BETWEEN

ATHABASCA LAKE AND CHURCHILL RIVER

BY

J. BURR TYRRELL,

ASSISTED BY D. B. DOWLING.

INTRODUCTION.

The present report is chiefly the result of an exploration carried out in the summer of 1892, to which is added the survey of the north shore of Lake Athabasca, made in the summer of 1893.

Assistance

During part of the summer of 1892, while we were travelling along the same routes, Mr. D. B. Dowling acted as my topographical assistant. During the remainder of the summer he travelled over and surveyed independent routes, and his reports on these are included between quotation marks.

The geographical survey of the north shore of Lake Athabasca was made by James W. Tyrrell, C.E., in 1893, acting as my assistant. When unaccompanied by either of these gentlemen the surveys were made by the writer.

Map.

The map accompanying this report has been compiled by Mr. Dowling from the above surveys, with the addition of the survey of Churchill River by Mr. T. Fawcett, D.L.S. The position of Fort Chippewyan, near the west end of Lake Athabasca is taken from Mr. W. Ogilvie's map of Athabasca River.

Early trade routes.

The Churchill River was first ascended from Frog Portage by some of the enterprising fur-traders from Montreal, who afterwards combined to form the North-west Company, and since that time it has formed one of the principal canoe-routes into the more distant country

on the banks of the Athabasca and Mackenzie rivers. Sir Alexander Mackenzie, Sir John Franklin, Sir John Richardson and Sir George Back, all travelled along this stream on their way to and from the north and have given many glowing accounts of the beautiful scenery on its banks, while maps of the river, chiefly based on the surveys made by David Thompson, afterwards astronomer on the International Boundary Commission, are published in their works.

T. Fawcett. In 1888, T. Fawcett, D.L.S., made a micrometer survey of the river from Methy Portage to Frog Portage, but the geological character of its banks, and of the surrounding country have, up to the present, remained unknown, except for the brief description by Sir John Richardson.*

P. Turner. In 1790, Philip Turner was sent by the British Government to Fort Chippewyan to determine the truth of some reports about the nearness of that place to the Pacific Ocean. In the following year, after determining the latitude and longitude of the fort, he made a survey of the north shore (or perhaps of both shores) of Lake Athabasca, as far eastward as the mouth of Stone River. His survey was doubtless incorporated in Arrowsmith's map of British North America, but no account of his journey is known to be in existence.

D. Thompson. In 1796, David Thompson left his Trading House on Churchill River, and ascended Reindeer River to Reindeer Lake, followed and surveyed the west side of this lake to Canoe River, ascended Canoe River, crossed Wollaston Lake, and descended Stone River to its mouth in Athabasca Lake, stopping at a "lobstick," cut by Phillip Turner at the end of his survey five years before. His map of the route is incorporated in his large manuscript map of the North-west Territories now in the possession of the Crown Lands Department of Ontario.

A. S. Cochrane. In 1880 and 1881, the late Mr. A. S. Cochrane, then a topographical assistant on the Geological Survey, made a track-survey from Cumberland House on the Saskatchewan, northward by Frog Portage to Reindeer Lake, thence northward and westward up the Cochrane or Ice River, down Stone River and along the north shore of Athabasca Lake to Fort Chippewyan, thence southward up Athabasca River to Fort McMurray, and thence eastward up Clearwater River and down Churchill River to Frog Portage, thus travelling round the area treated of in this report. No report of this expedition was prepared or published, but Mr. Cochrane's note books were of considerable service as

*Arctic Searching Expedition by Sir John Richardson, vol. I., pp. 92-102, London, 1851.

a guide during the ascent of Stone River, and the upper portion of Cochrane River is laid down on the map from his survey.

Of the geography of the interior of the country within Mr. Cochrane's line of travel, embracing an area of about 60,000 square miles, nothing was definitely known before the present exploration was undertaken.

Modes of survey.

In carrying out the surveys here reported on, the party travelled chiefly in Peterborough canoes. The bearings throughout were taken with prismatic or by solar compass, observations being made daily, when possible, for variation. The distances on lakes and quiet water were measured with a Massey's floating boat-log, those on the Stone and Reindeer rivers with a Rochon micrometer, and the remainder were estimated by the rate of travel. Observations for latitude were taken almost daily with a sextant of 8-inch radius. A short itinerary of the journey of 1892 is given in the Summary Report of the Geological Survey for that year (pp. 12A-25A.)

The total length of Athabasca Lake, surveyed in 1893, was determined by means of a pocket chronometer (Frodsham, No. 9697), which had been carefully rated both at the Meteorological Observatory in Toronto, and during our stay at Fort Chippewyan.

Determination of rocks.

In regard to the microscopic determination of some of the rocks mentioned in the sequel, I desire to acknowledge the assistance of Prof. F. D. Adams of McGill University, and Mr. W. F. Ferrier of this Survey.

PHYSICAL GEOGRAPHY.

Area.

The present report refers chiefly to an area of about 60,000 square miles, bounded on the south by the Churchill and Clearwater rivers; on the west by the lower portion of Athabasca River; on the north by Athabasca Lake, Stone River, with its expansions, Black and Hatchet Lakes, Wollaston Lake and Cochrane or Ice River; on the east by the lower part of Cochrane River, Reindeer Lake and Reindeer River. It lies between north latitudes 55° 20′ and 59° 37′, and east longitudes 101° and 111° 30′.

Between the Churchill and Saskatchewan rivers two lines were examined, one from Prince Albert north-westward by Green Lake to Ile à la Crosse, and the other from Stanley Mission south-westward by Montreal Lake to Prince Albert.

River system.

North of the Saskatchewan basin the country is drained by two main streams; the Churchill River, which flows eastward, and finally,

after a course of about 1100 miles, discharges its waters into the west side of Hudson Bay at old Fort Prince of Wales; and the Athabasca-Mackenzie River, which carries its waters northward to the Arctic Ocean. These two drainage systems inosculate in Wollaston Lake, which discharges by almost equal streams into both.

Churchill River.

Churchill River, from its northern source at Portage la Loche, following its windings, has a length of 480 miles to the mouth of Reindeer River. It is a long series of very irregular lakes filled with clear blue water, connected by short and usually rapid reaches. The banks are low and thickly wooded with spruce and poplar. Some of the rapids are produced by rocky barriers, while others are over boulders and between banks of till, such as underlies much of the surrounding country. For a considerable part of its course it appears to flow near the line of contact of the Archæan and overlying unaltered rocks, though the topography is modified by the occurrence of strong glacial features.

The absence of a valley, even where the channel might be easily eroded, and the occurrence of the numerous lakes and rapids, shows that the river is, geologically speaking, very new.

The largest tributaries flowing into Churchill River from the south are Beaver, Sandy and Rapid rivers.

Beaver River.

Beaver River rises on the Cretaceous plateau, not far from Lac la Biche, and flowing first eastward for two hundred and fifty miles, and then northward for a hundred miles, empties into the south end of Ile à la Crosse Lake. Its course northward was alone surveyed. Here it is a rapid stream from 100 to 200 feet wide, flowing between low clay banks beautifully wooded with spruce and poplar. Much of the land along its course appeared to be well adapted for agricultural purposes, and the rank vegetation gave promise of abundant harvests.

Of Rapid or Forks River, Mr. Dowling writes as follows:—

Rapid River.

"This river enters the Churchill at Forks Lake, below the lake-expansion at Stanley Mission. It is the outlet at Lac La Ronge, a large oval-shaped lake having a length of nearly thirty-five miles, situated at a short distance to the south-west. This short stream has a heavy fall or series of rapids near the confluence with the English River. One of the tributaries entering the southern end of Lac La Ronge is the Big Stone River, from a lake of the same name a short distance above, and having for its chief branch the Montreal River, coming from the northern slope of the plateau crowned by

Montreal Mountain. It drains Montreal Lake which has an extent of thirty miles in length by about eight broad, as well as Deer Lake and several others of lesser size to the south-west. From Montreal Lake to near Big Stone Lake the stream cuts a valley through sandy deposits, but below this there is no well-defined valley. The general surface of the upper part is sandy, sustaining a growth of small pine, but in the vicinity of Lac La Ronge the prevailing character is more rocky, with spruce in the low ground."

The principal tributaries of the Churchill River from the north are the Mudjatick, Haultain, Foster and Reindeer rivers.

Mudjatick River is a swift, winding stream about eighty miles in length, generally flowing in a shallow channel through a sandy plain, in the bottom of a wide depression between ridges of granite. It is obstructed by comparatively few rapids, and these are for the most part over ridges of boulders. Its banks are thinly wooded with Banksian pine and spruce, and there is no soil of any value for agricultural purposes. Mudjatick River.

Haultain River was not examined, but at its mouth it seems to be about as large as Mudjatick River. Haultain River.

Foster River is very similar in size to the Mudjatick River, but it is altogether a wilder and rougher stream. Rising in the Foster Lakes it plunges down a series of heavy rapids over ridges of granite and gneiss until it approaches within a few miles of Churchill River. Here it enters a country more thickly covered with drift, and more densely wooded. Abandoning its direct course south-westward, it sweeps round in a long curve and finally empties into a northern arm of Black Bear Lake, one of the expansions of Churchill River. Foster River.

Reindeer River is a wide, quiet stream seventy miles long, flowing southward from Reindeer Lake. It is obstructed by but four rapids. Its banks are generally low, and the stream rarely impinges against the rocky hills which compose the surrounding country. Reindeer River.

Reindeer Lake, from which Reindeer River flows, has an area of about 2200 square miles, and an elevation above the sea of 1150 feet. Its water is very pure and clear. It has a very irregular contour, and is dotted with innumerable rocky islands, these and the rocky shores being generally thinly covered with a sparse growth of small black spruce. Cochrane or Ice River is the largest stream flowing into Reindeer Lake. It takes its rise in Wollaston Lake, and flows at first eastward and then southward through a thinly wooded country, much of which is characterized by irregular sandy and stony hills. Reindeer Lake.

Wollaston Lake.

Wollaston Lake, though smaller than Reindeer Lake, is very similar to it in general character. Its irregular shores are chiefly composed of thinly wooded rocky hills, while very many rocky islands rise abruptly out of its clear blue water.

Geikie River.

Geikie River is, as far as known, the principal tributary of Wollaston Lake. It rises in some small lakes near the source of Foster River, and flows north-eastward through a thickly drift-covered country between low sparsely wooded banks. For long stretches it is straight and without current, giving it the appearance of a wide, quiet river or chain of long narrow lakes.

Watershed.

Wollaston Lake is the dividing line between the waters flowing to Churchill River and those flowing to the Mackenzie, for it is not only drained by the Cochrane River, but Stone River flows from its north-western angle.

Stone River.

This latter stream flows generally westward, at first through several small lakes in a country underlain by granite and gneiss and then, in a shallow channel, through a gently sloping country underlain by horizontal sandstone. In this portion of its course it is a swift stream, obstructed by many rapids, in which the water rushes over ledges or irregular masses of sandstone. The banks are sandy and poor, supporting but a short growth of small spruce and Banksian pine. In the lower part of its course it passes through Black Lake, below which it falls in a series of heavy rapids into the east end of Athabasca Lake.

Cree River.

Several tributaries join the Stone River from the south, but only one, the Cree River, was examined. This stream is very similar in character to Stone River itself, flowing from Cree Lake in a shallow channel, through a level sandy country. It is obstructed by many rapids, where the water passes over rough broken masses of sandstone. The surrounding country is sandy and very barren, supporting but a scanty growth of black spruce and Banksian pine, with very little underbrush.

Athabasca Lake.

Athabasca Lake is a long and comparatively narrow sheet of water, extending westward from the mouth of Black River to where the Athabasca-Mackenzie River drains the country towards the north. It lies in the bottom of a great valley excavated along the line of contact of the Archæan granites, etc., to the north, and the undisturbed Palæozoic sandstone to the south. On its south side is a great sandy plain, rising at its east end to a height of 500 feet above the lake, and gradually sloping westward towards the Athabasca-Mackenzie valley. The country to the north is composed of rugged,

rocky hills, with a general slope in the same direction, but seen from the lake the slope is not so pronounced as in the level country to the south. Towards the eastern end of the lake the water is clear and pure, but at its western end it is rendered turbid by the muddy water discharged into it by the Athabasca River.

The district at present under consideration, lying north of the Churchill River, may be divided into two parts having different surface characteristics—that underlain by Archæan gneisses, granites, etc., and that underlain by horizontal Palæozoic rocks. The former consists of low, rocky hills and ridges from fifty to a hundred and fifty feet in height, between which are more or less extensive areas characterized by sand or by boulder-clay, thickly wooded with stunted spruce, containing small irregular lakes of beautiful transparent water. The latter is a monotonous sterile plain which, in its better drained portions, is thinly wooded with Banksian pine, without underbrush. Lakes are conspicuously absent, while the small streams flow over the surface in shallow channels. In both subdivisions the surface contour is low and little pronounced, the lower lands around the margin of the area, for the most part lying at an elevation of more than 1000 feet above the sea, while the lakes and plains in the vicinity of the watershed, in the centre of the area, are from 1500 to 1600 feet above sea-level, and some of the surrounding hills may be 150 feet higher. No deep valleys that might have been cut by the present streams or their preglacial representatives were seen. If such valleys existed previous to the glacial epoch they have been filled by glacial débris, and the streams now flow in shallow channels. In places, some of the streams seem to flow in the bottom of valleys from 100 to 200 feet deep, but on investigation the steep banks are discovered to be the sides of narrow ridges of glacial débris, described on a later page as Ispatinows.

Archæan area.

Palæozoic area.

Low contour.

No valleys.

The country between the Saskatchewan and the Churchill rivers is very different from that north of the latter stream. From Prince Albert, situated on the banks of the North Saskatchewan, at an elevation of 1400 feet above the sea, the surface rises with a gentle slope northward to a heavy stony morainic ridge, the highest point of which, on the Green Lake trail, was found to have an elevation of about 2220 feet. From this high ridge the country slopes gradually northward, at first with a gently rolling, and afterwards with a more even surface, to the chain of lakes and extensive swamps that lie along the edge of the district directly underlain by Archæan rocks. Most of the streams south of the high morainic ridge flow in deep valleys excavated in the boulder-clay and the underlying soft Cretaceous rocks, while to the north

Cretaceous plateau.

of the ridge, Green Lake lies in the bottom of an old valley which is not improbably of preglacial age. This country has very much the general appearance of that portion of north-western Manitoba to the west of lakes Manitoba and Winnipegosis, including the Duck and Riding mountains, previously described by the writer.*

Elevations. The following is a list of elevations of some of the more important points, determined by aneroids, compared with standard mercurial barometers read at Prince Albert and Chippewyan :—

	Feet.
Summit, Green Lake Trail	2220
Green Lake	1440
Ile à la Crosse Lake	1330
Knee Lake, Churchill River	1250
Cree Lake	1530
Black Lake	1000
Wollaston Lake	1300
Foster Lake	1600
Black Bear Lake, Churchill River	1200

Forest trees. The country is generally forested, though most of the timber is small black spruce (*Picea nigra*) and tamarack (*Larix Americana*). Banksian pine (*Pinus Banksiana*) forms thin park-like woods on the sandy plains. White spruce (*Picea alba*) forms some groves of fair size in the bottom lands near the Churchill River, but farther north it is rarely seen except in some particularly favourable localities. One small isolated grove of white spruce was found on a high sandy island in Hatchet Lake, standing out conspicuously in the midst of the surrounding forest of small black spruce. Poplar (*Populus tremuloides*) and birch (*Betula papyrifera*) are the only remaining forest trees of any importance. They are found chiefly in the vicinity of Churchill River, though small scattered trees were seen on the banks of Stone River.

Berries. In places some of the more northern berries grow in great profusion, chief among which are the common huckleberry (*Vaccinium Canadense*) and the small cranberry (*Vaccinium Vitis-Idœa*). The former grows in the deciduous woods along the Churchill River, while the latter covers the dry slopes from the Saskatchewan northward. The blue huckleberry (*Vaccinium uliginosum*) grows on the banks of Cree and Stone rivers, but the bushes did not seem anywhere to bear much fruit. The raspberry (*Rubus strigosus*) grows on the richer ground by some of the streams. The yellow swamp-berry (*Rubus chamæmorus*) is found abundantly in the moss of the wet spruce and

* Annual Report Geol. Surv. Can., vol. V., part E., 1890-91.

tamarack swamps. The crowberry (*Empetrum nigrum*) occurs on the drier land towards the north, and the Pembina berry (*Viburnum pauciflorum*) grows in the deciduous woods beside the streams, especially in the southern portion of the district.

The fauna of the district is represented by a considerable number of species, but in many cases the number of individuals is not large.

Mammals.

The moose (*Alces Americanus*) roams through the more thickly wooded parts of the country as far north as Stone River, which is probably near the northern limit of its range. Seven individuals in all were seen during the course of the summer. The woodland caribou (*Rangifer caribou*) is said to occur in the more southern portion of the district, near Churchill River, but none were seen. The barren ground caribou (*Rangifer Grœnlandicus*) comes south in winter to the south end of Reindeer Lake and the upper portion of Mudjatick and Foster rivers. It travels north in spring to the Barren Grounds, but a very few animals are occasionally left behind, one having been shot in July near the north end of Cree Lake. The Canada lynx (*Lynx Canadensis*) is moderately abundant in some seasons in the more southern part of the district. The gray wolf (*Canis lupus occidentalis*) roams over the country, but is not plentiful. The coyoté (*Canis latrans*) is found occasionally as far north as the height of land, one having been shot by the writer on one of the small lakes near the source of Foster River. It is, however, certainly not common in the district.*

Red, black and cross foxes (*Vulpes vulgaris*), wolverene (*Gulo luscus*), marten (*Mustela Americana*), weasel (*Putorius vulgaris*), mink (*P. vison*) and skunk (*Mephitis mephitica*) are all found in greater or less abundance in the rolling wooded country underlain by Archæan rocks. The otter (*Lutra Canadensis*) was found on all the streams north to Stone River. The black bear (*Ursus Americanus*) roams over the whole country. A few beavers (*Castor fiber*) may still be met with in many of the streams. A considerable colony was found in the untravelled country near the source of Geikie River, but our canoemen brought back word of this (to the Indians) important discovery, and doubtless the beaver were killed during the following winter. The muskrat (*Fiber zibethicus*) was seen swimming in all the streams. The rabbit or American hare (*Lepus Americanus*) is found everywhere in the denser woods, but it did not seem to be anywhere abundant. The porcupine (*Erethizon dorsatus*) was plentiful

* Further west, it finds its northern limit at Athabasca Landing. G. M. D.

around Cree Lake, and in those portions of the sandy country that had not recently been hunted over by Indians. The red squirrel (*Sciurus Hudsonius*) and the northern chipmunk (*Tamias Asiaticus*) were found everywhere in the wooded country. Doubtless many other of the smaller species of mammals occur, but they were not observed.

Birds. The time at our disposal did not permit us to make a close examination of the birds seen, but generally speaking, except along the banks of Churchill River, where ducks breed in great numbers, birds are not at all numerous in the district explored. With the exception of one or two species of merganser, but few ducks were seen, as there is very little food for them in the clear lakes and rivers. The great northern and red-throated divers were moderately abundant on the lakes. No swans and very few geese of any species were seen. Coveys of ruffed grouse and spruce partridge were found in the thicker woods everywhere. A few snowy owls and bald-headed eagles were observed, and a large golden eagle was shot beside its nest on a rocky cliff overlooking Stone River.

Fish. Fish seem to be everywhere abundant in the lakes and streams, but the number of species is very limited. The lake trout (*Cristivomer namaycush*) is, however, the largest of the finny tribes. One was caught near the mouth of Stone River weighing twenty-five pounds. The white fish (*Coregonus clupeiformis*) is found everywhere throughout the district, but more especially in the shallower lakes. The blue fish or Back's grayling (*Thymallus signifer*) was caught in Stone River at the foot of the heavy falls below Black Lake. Pike (*Esox lucius*), pickerel (*Stizostethium vitreum*), methy (*Lota lacustris*) and two or more species of suckers (*Catastomus teres* and *Myxostoma macrolepidota*) were found in almost all the water stretches.

Natives. The number of Indians who live in and travel through the country, obtaining a precarious existence by hunting and fishing, is very small. They are centred around four trading posts, namely, Methy Portage, Ile à la Crosse, Rapid River or Stanley, and the south end of Reindeer Lake. Those that trade at the last two posts are chiefly Crees or Nahathaways, while those at the two former posts are mostly Chippewyans. A few Chippewyans also come south-west into the country from Du Brochet Post, at the north end of Reindeer Lake. The total number hunting in the district is probably not more than three or four hundred in all, or about one person to every 150 square miles.

GENERAL GEOLOGY.

The rocks examined in the district covered by the present report, and described in detail in its later portion, may be tabulated as follows :—

RECENT.

Present lake beaches, and flood-plains of the present streams.

PLEISTOCENE.

Sand plains near the height of land, along Mudjatick River, &c.
Ancient shore-lines around Hyper-Cree Lake, Hyper-Black Lake, &c.
Till, drumlins, moraines, kames, eskers, ispatinows.

CRETACEOUS.

Pierre —Dark gray shales.
Niobrara-Benton.—Calcareous shales.
Dakota.—Sandstones, mostly incoherent.

CAMBRIAN.

Athabasca Sandstone (Keewenawan).—Red sandstones and mottled sandy shales, in more or less horizontal position.

HURONIAN.

White quartzites, fine red calcareous sandstones, hälleflintas and thinly foliated green schists, seen on the north shore of Lake Athabasca.

LAURENTIAN.

Hornblende- and mica-granites and granitoid gneisses, norites and gabbros, often showing signs of severe crushing and contortion.

LAURENTIAN.

The name Laurentian is applied in the aggregate to the crystalline, altered, crushed and contorted rocks of the basement complex, consisting in this region of hornblende-granites, biotite-granites, muscovite-granites, and granitoid gneisses of the same composition, with gabbros

Basement complex.

and norites. These are all welded closely together, and, although some are clearly intrusive in the others, and therefore younger, they are necessarily classed in one great group in default of evidence rendering it possible to arrange them in any definite time-series, in this region.

Extent of area underlain by gneiss.

These rocks are found outcropping on Churchill River, from two miles below the mouth of Mudjatick River eastward to the mouth of Reindeer River, beyond which the river was not examined. Thence northward they occupy the whole, or almost the whole of the eastern part of the district, while further west they extend northward to Cree Lake, where they disappear under the overlying Athabasca sandstones. North of the sandstone area they occupy most of the northern shores of Athabasca and Black lakes. Throughout the greater portion of the area, the rock consists of light reddish-gray hornblende-granite, and biotite-granite or granitoid gneiss, worn into low rounded hills and ridges. The gneiss does not appear to have any very persistent strike. In thin sections under the microscope, much of the gneiss exhibits cataclastic structure, showing it to have been subjected to severe strain and crushing. Some areas were found to be underlain by a white muscovite-granite. This is typically developed east of Hatchet Lake and in some islands in Wollaston Lake, and is doubtless intruded through the surrounding hornblende-granite-gneiss. On Mudjatick River the rock is for the most part a similar whitish granite, which, however, is often found to be more or less distinctly foliated.

Gabbro.

On the north shore of Athabasca Lake, west of Fond du Lac, is an area of medium-grained reddish gabbro, in places crushed and showing a distinct foliation, but how it is related to the surrounding gneisses was not determined. On the same shore, twenty miles east

Norite.

of Fond du Lac, a range of dark-gray, rocky hills rises to a height of several hundred feet above the water, and continues eastward for fifty miles, to the north-west shore of Black Lake. The rock, which doubtless represents an intrusive mass, consists essentially of a pleochroic, orthorhombic pyroxene, probably hypersthene (often altered to brown hornblende), plagioclase, some quartz and ilmenite. It may therefore be classed as a norite. In some places it is heavily jointed and almost massive, while in other places it shows a well marked gneissic structure. Near the shore it is occasionally seen in contact with reddish-gray biotite-gneiss, and near the line of contact garnets have been developed in the norite in great abundance. They are also found, though not quite so abundantly, in the biotite-gneiss.

HURONIAN.

As far as is at present known, the Huronian is represented in this district solely by three small areas on the north shore of Lake Athabasca. The most important of these is just east of the long point east of Black Bay, and extends for sixteen miles along the shore. It consists of a hard, white, crushed quartzite, in which heavy bedding can often be detected. It lies on the gneiss in a wide syncline and strikes in a more or less northerly direction, apparently covering a large ∧ shaped area. On its eastern border, near the line of contact with the adjoining gneiss, is an extensive development of hæmatite, often associated with a coarse quartzite breccia. From the top of a hill, this ridge of hæmatite was seen to extend a long distance inland along the strike of the quartzite.

Area underlain by quartzite.

Near the north-west angle of Black Bay, on Slate Island, the Huronian is represented by dark-brown thinly foliated ferruginous chlorite schists, associated with a band of coarse green conglomerate, with well rounded pebbles and a scanty chloritic matrix; and two miles further west, on the main shore, is an exposure of thickly foliated light-green hälleflinta, interlaminated with bands of granite. Similar green schists were also seen on the shore for several miles to the south-west of the mouth of Cypress River.

Ferruginous schists at Slate Island

Between twenty-five and thirty miles north-east of Fort Chippewyan, the shore is bordered for several miles by green and red calcareous quartzose schists, striking parallel to the edge of the lake, with nearly vertical dips. They lie at the foot of a rather high ridge of Laurentian gneiss, and towards the south they seem to pass into a fine-grained, highly altered, red calcareous sandstone.

Calcareous schists.

CAMBRIAN.

Athabasca Sandstone.

This is an extensive series of generally horizontal red sandstones and conglomerates, resting on the uneven surface of the Archæan granites and gneisses. The sandstone was previously seen by Mr. McConnell at two places on the south side of Lake Athabasca, and placed by him in the Cambrian, with the local designation of "Athabasca Sandstone."*

*Report on a portion of the District of Athabasca, by R. G. McConnell. Annua Report Geol. Surv. Can., vol. V. (N.S.), 1890-91, p. 51 D.

In 1892, no further information respecting the age of these sandstones was obtained by the writer, but in the following year, while exploring the country northward towards Chesterfield Inlet, similar sandstones were found overlying the Archæan, associated with quartz-porphyries, diabases, &c., like those of the Keewenawan rocks of Lake Superior. The likeness is so pronounced throughout, that there would seem to be little doubt that the two sets of rocks belong to the same geological horizon.

Horizontal red sandstone.

The formation is everywhere much the same in this district, consisting chiefly of a reddish, moderately coarse-grained quartzose sandstone. At some places near the base of the series, especially on the north shore of Lake Athabasca, the rock becomes a coarse conglomerate, with well-rounded pebbles of white clastic quartzite like that of the neighbouring Huronian rocks. In other places, as on Wapata Lake, it is a fine-grained, thin-bedded red shaly sandstone, mottled with rounded spots of a greenish-gray colour.

Diabase dyke.

It is almost everywhere nearly horizontal, the exceptions to this rule being slight and local. It was not found to be cut by eruptive rocks except at one point on the west shore of Cree Lake, where a dyke of coarse, light-green uralitic diabase has cut through it, and altered the sandstone on both sides to a hard quartzite.

Area underlain by sandstone.

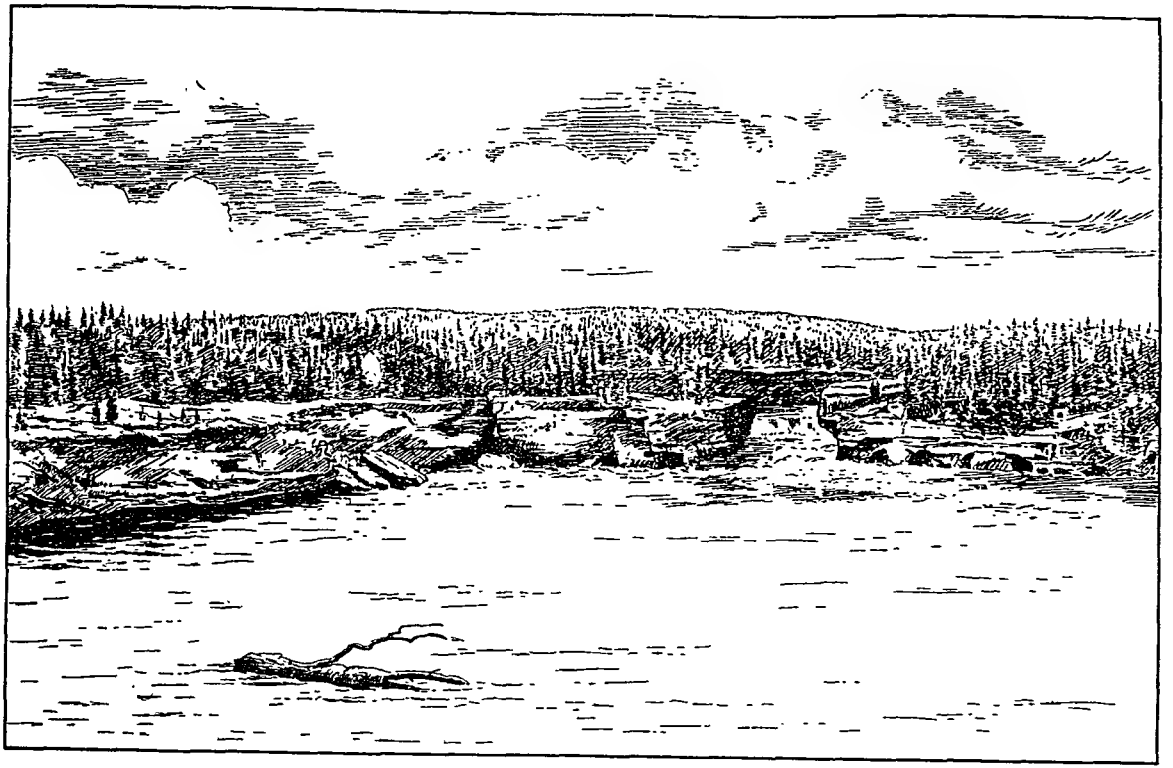
The total area underlain by this sandstone formation is very large, extending from Cree Lake on the south to Athabasca Lake on the north, and from Wollaston Lake on the east, doubtless to the vicinity of the valley of Athabasca River on the west, and perhaps much further under the covering of later rocks. Cree Lake lies largely within the area underlain by these rocks, and Athabasca Lake seems to lie entirely within it, for the red sandstones compose many of the islands and more prominent points of its northern shore.

Thickness of sandstone.

On account of the generally horizontal position of the beds, and their similarity in character throughout, it was impossible to determine its greatest or total thickness, but near the east end of Lake Athabasca cliffs of sandstone rise on the south shore to the height of between 400 and 500 feet, giving a vertical section of over 400 feet at this point.

Rocks newer than Cambrian.

East of the basin of Athabasca River, in the region explored, no rocks of later age than the Athabasca sandstone were seen north of the Churchill. If any such were deposited they have long since been denuded away. That at some uncertain period previous to the Glacial epoch the country stood at a much higher level, or sloped much more



J. B. TYRRELL.—Photo., Aug. 12, 1892. L. M. LAMBE, delt.

MANITOU FALLS, STONE RIVER.
Showing Athabasca sandstone, with hills of drift in the background.

steeply westward, than it does at present, is shown by the existence of the great valley occupied by Athabasca Lake. Possibly this valley was eroded while the Cretaceous sandstones and shales were being deposited in the seas then stretching away to the south, or afterwards in the Tertiary period, during part of which clays and sands were being deposited on the bottom of a gulf then occupying the position of the present valley of the lower reaches of Mackenzie River. Old valley.

On Churchill River, between Ile à la Crosse and the mouth of Mudjatick River, the country is thickly covered with drift, so that none of the underlying rocks were seen, but it is highly probable that Palæozoic and probably Cambro-Silurian, Silurian or Devonian limestones, or all three, similar to those of the Winnipeg basin, might be found beneath the drift, overlying the Archæan gneisses. As evidence of the presence of these rocks, boulders of Palæozoic limestone, carried with the drift from the north, were found on Ile à la Crosse Lake and southward. At Grand Rapids, on Beaver River, a limestone boulder was seen, holding fossils, one of which appeared to be a *Trochonema* of the type of *T. umbilicatum*. On the banks of Big River another boulder was found holding *Receptaculites Oweni*. Both these boulders were evidently derived from rocks of Cambro-Silurian age, and indicate the presence of such rocks to the north, along the southern edge of the Archæan. Some of the boulders on Ile à la Crosse Lake are of dolomitic limestone, containing such fossils as *Atrypa reticularis*, *Fenistella vera (?)*, a large Stromatoporoid, etc., and were, doubtless, derived from Devonian rocks. Country drift-covered. Boulders of Palæozoic limestone.

In the north-west portion of the district, Devonian limestone was seen outcropping for several miles in the bottom of the valley of Fire-bag River, one of the small tributaries of Athabasca River.

Cretaceous.

South of the Churchill River, the country is almost entirely underlain by Cretaceous rocks, ranging in age from the Dakota sandstone up to the Pierre shales.

On the south shore of Ile à la Crosse Lake, a few miles west of Ile à la Crosse post, there is a low outcrop of soft, horizontally bedded, light-yellow sandstone, associated with thin beds and nodules of calcareous ironstone. It contains many carbonized plant remains. Though no recognisable fossils were here found, it is confidently believed that these beds belong to a horizon not far from the bottom of the Dakota sandstone. Sandstone on Ile à la Crosse Lake.

Dakota.

On Beaver River, just above the mouth of Doré River, are some banks ninety feet high of soft incoherent white or light-yellow sandstone, very similar in character to much of the Dakota sandstone of north-western Manitoba, and probably also of Dakota age. In the valley of Fire-bag River, four feet of 'tar sandstones' (Dakota?) were seen overlying the Devonian limestone.

On Beaver River, no Cretaceous rocks were recognised above the horizon of the Dakota, but at the Grand Rapids a boulder of Cretaceous limestone was found holding fragments of a *Cypina*-like shell, perhaps derived from some of the lower beds of the Niobrara in the vicinity, or a short distance farther north.

Niobrara shale.

Near the south end of Green Lake, typical Niobrara shale, containing large numbers of Foraminifera, fragments of shells of Inoceramus, bones of fishes, &c., was seen near the edge of the water, having slidden out from the foot of the high bank. The recognition of Niobrara rocks on Green Lake carries the knowledge of the occurrence of this horizon 275 miles north-westward from the nearest point at which it had previously been found, near the north-west corner of the province of Manitoba, and more than half way from that point to the Athabasca River. From Green Lake southward to the Saskatchewan River, the country appears to be entirely underlain by Pierre shales, though very few exposures were seen.

After the close of the Cretaceous period, a time of continental elevation must have set in, and appears to have continued throughout the Tertiary and down to the present time.

Pleistocene.

Glaciated surfaces.

Wherever the surface of the underlying rock is seen, it has been severely glaciated, and any rocky prominences are rounded on the side looking towards the direction from which the glacier flowed, and rough and broken on the opposite side. The surfaces are not smooth and polished as they are in many places further south, for the till that had been dragged over them by the glacier contained very little clay or other fine polishing material, but was rather composed of sand or rock-flour. Coarse grooves and striæ were often seen, though they are not everywhere present. Their direction is shown by the arrows on the accompanying map. The most of them belong to one period of glaciation, and were made by the south-western extension of the great glacier centring west of the northern part of Hudson Bay, and for which I have proposed the name Keewatin glacier. They indicate that this

Keewatin Glacier.

last great glacier flowed between S.S.W. and S.W. across the greater portion of the area, being diverted westward in the valley of Lake Athabasca. No general glaciation, distinct from the above, could be detected.

The following is a list of the glacial striæ observed in the area of the map:— Glacial striæ.

Place.	True Bearing.
Mudjatick River, near mouth	S. 17 W.
" lat. 56° 18′	S. 22 W.
" below Grand Rapids	S. 52 W.
" Forks	S. 22 W.
" above Forks	S. 17 W.
River flowing N. to Cree Lake	S. 27-17 W.
Cree Lake, camp at S. end	S. 37 W.
" Small Island	S. 27 W.
" sandstone cliff at S. W. side	S. 37 W.
" " at north end	S. 17 W.
Black Lake, west shore, south of Stone River	S. 72 W.
Woodcock Portage	N. 73 W.
" west end	S. 71 W.
Black River	N. 58 W.
"	N. 63 W.
" below lowest portage	S. 77 W.
" " "	N. 83 W.
"	S. 63 W.
Athabasca Lake (from east to west)	S. 55 W.
" " earlier striæ	S. 74 W.
" "	S. 87 W.
" "	N. 70 W.
" "	S. 20 W.
" " earlier striæ	S. 66 W.
" "	S. 51 W.
" "	S. 53 W.
" "	S. 62 W.
" " later striæ	S. 34 W.
" "	S. 61 W.
" "	S. 41 W.
" "	S. 58 W.
" "	S. 71 W.
Fond du Lac	S. 51 W.
	N. 82 W.
east of Beaver River	S. 60 W.
west of Beaver River	S. 42 W.
near Red Hill	S. 45 W.
S. E. of Black Bay	S. 75 W.
near Cypress River	S. 50 W.
Lat. 59° 6′ 30″	N. 75 W.
" Standing Sand Point	S. 65 W.
Fort Chippewyan	N. 75 W.
Black Lake, Sandstone Island	N. 76 W.
point of granite	S. 48 W.
" later striæ	S. 68 W.

Place.	True Bearing.
Black Lake, Island	S. 56 W.
"	S. 71 W.
" point on north shore	S. 58 W.
"	S. 70 W.
Hatchet River, lowest portage	S. 87 W.
" ascending the stream	S. 76 W.
" "	S. 76 W.
" "	S. 61 W.
" "	S. 78 W.
" Perpendicular Rock	S. 51 W.
"	S. 44 W.
Hatchet Lake	S. 23 W.
"	S. 26 W.
Wollaston Lake, (from north to south)	S. 11 W.
" "	S. 14 W.
" "	S. 29 W.
" "	S. 31 W.
" "	S. 33 W.
" "	S. 27 W.
Geikie River, 1 m. above Poor Fish River	S. 30 W.
"	S. 87 W.
"	S. 18 W.
" north of Big Sandy Lake	S. 28 W.
"	S. 37 W.
" above lake	S. 35 W.
" lake near source	S. 23 W.
" " "	S. 23 W.
" " " older striæ	S. 35 W.
Lake west of Foster Lake	S. 40 W.
Little Whitefish Lake, narrows	S. 31 W.
" "	S. 32 W,
Lake below Little Whitefish Lake	S. 22 W.
Jumping-in-the-Water Lake	S. 40 W.
Mouth of Foster River	S. 36 W.
Churchill River, near Foster River	S. 39 W.
" west end of Needle Lake	S. 24 W.
" mouth of Souris River	S. 43 W.
" " " "	S. 50 W.
" near Hay River	S. 43 W.
" Lowest Deer Rapid	S. 20 W.

Till. Over the country directly underlain by Archæan rocks, there is but a scanty coating of till, chiefly lying in the bottoms of the depressions, but on the more even surface of the Palæozoic rocks the till is present in much larger amount, often assuming a gently undulating contour.

Moraines. Large well defined morainic ridges are seldom seen towards the north, and those which can be made out consist of an accumulation of a great number of boulders; but further south a great rugged morainic area extends along the crest of the country between the Churchill

and Saskatchewan rivers, forming a region similar to the summit of the Duck and Riding mountains in Manitoba.

Drumlins occur in a number of places, as in the valley of Mudjatick River, where many of them have cores of the underlying rock. Drumlins.

Kames, or disjointed ridges of sand and gravel, were seen in some of the morainic areas, especially on the upper part of Stone and Geikie rivers. Kames.

Sandy eskers occur, running with the striæ, in a few places, as on Hatchet and Wollaston lakes, and on the banks of Geikie River. Eskers.

The most conspicuous and interesting drift hills in the whole region, however, occur in the basin of Cree Lake, around Black Lake and on the banks of Stone River. They are steep, narrow ridges, parallel to the direction of glaciation, with the sides joining in a crest that may be less than a yard in width. They average from a quarter of a mile to one mile in length, and round down gently to both ends with a characteristic drumlin-like contour, and vary from 70 to 250 feet in height, the average being about 120 feet. Unlike eskers, or kames, which they resemble in some respects, they are not composed of assorted material, but rather of unassorted rock-flour mixed with boulders. Unlike drumlins, they do not seem to have been ever compacted or overridden by the ice, as the material is loose, and the summit is not rounded off from side to side, but rather from the crest downwards, they descend in as steep a slope as the material will stand at. Further, they all lie in the basins of large post-glacial lakes, the principal ones examined being in Hyper-Cree and Hyper-Black lakes. As they seem to differ from any drift hills that have been definitely described, I would suggest for them the name ispatinow, the Cree word for a conspicuous hill. Ispatinows.

Their shape, and the character of their material, with their position, induce one to believe that they were formed in narrow gorges in the ice-sheet, when the front of the glacier was bounded by a deep lake. Streams flowing on or near the surface plunged into those ice-bound gorges and carried their load of detritus into the quiet water at the bottom of the gorge. In some such way as this these narrow ispatinows might have been formed of loose unassorted material, and as the icy walls receded or melted away and the lake was drained, the sides would assume a slope as steep as possible. Mode of formation.

North of the watershed between Churchill and Stone rivers, most of the lakes appear to have stood at a higher level than they do at pre- Glacial lakes.

sent, in the time immediately subsequent to the retirement of the great ice-sheet. The natural inference is that they lay between the face of the waning ice-sheet and higher land over which the water flowed to form the great rivers of the glacial period. In order to avoid a multiplicity of names that are difficult to remember, and none of which can be located from an ordinary geographic map of the present day, it is here proposed to add the prefix *hyper* - to the name of the present lake or river to designate the former high-level lake that occupied its basin or valley. For example, around the southern and western shores of Cree Lake, well-defined shore-lines were found up to eighty feet above the present water-level. It is proposed to call the lake that formed these old shore-lines Hyper-Cree Lake. This lake extended from the height of land northward to about the north end of Cree Lake, where its waters probably laved the foot of the Keewatin glacier. Towards the east and the west its extent is unknown, but it covered what are now wide sandy plains, extending out in these two directions.

Hyper-Cree Lake.

The lake did not exist for any great length of time, as its shores are but slightly marked, its gravel beaches being small, and its coast-cliffs but slightly cut, even in soft material. On its south side, forming the present height of land, is a wide sandy plain, in which are many deep closed depressions, probably indicating the position of heavy masses of ice. Stretching southward from this plain, down the course of Mudjatick River, is a large amount of sandy material, often stretching out into wide sandy plains. This extent of sand doubtless marks the line of one of the water-courses draining the face of the glacier at about the time that Hyper-Cree Lake came into existence.

In the same way Hyper-Black Lake stood one hundred and twenty-five feet above the present level of Black Lake, and extended for a long distance up Cree and Stone rivers. Hyper-Athabasca Lake rose above the present level of Lake Athabasca, as is shown by the beautiful raised beaches on Beaver-lodge Island, and the wide sandy plains seen by Mr. Dowling on William River; but whether it at any time was confluent with Hyper-Black Lake was not determined. Hyper-Wollaston Lake occupied the basin of Wollaston Lake, and extended a considerable distance up Geikie River. Hyper-Churchill Lake lay in the present valley of Churchill River, and, when at its greatest height, seems to have extended southward as far as the sand-hills around Clearwater Lake on the Green Lake trail.

Hyper-Black Lake, &c.

It is highly probable that some of the great post-glacial lakes of the region were at times connected, but much further exploration would be

be needed to define their coast-lines, and to determine their relationship to each other.

Recent.

The shores of the present lakes are nowhere strongly marked by deeply cut cliffs or heavy beaches. In the northern area the streams flow in shallow channels, having only in rare and local instances, even when flowing through clay or incoherent sand, cut down their beds to a base-level of erosion. On the Cretaceous plateau, the small diminished streams often wind through the bottom-lands of deep, wide valleys, never even impinging against their high grassy banks. The present streams are not deepening these valleys to any appreciable extent. Present shore lines.

DESCRIPTION OF ROUTES.

Green Lake Trail.

North of the Saskatchewan, the road from Prince Albert passes for several miles over a range of barren sandy hills at the same elevation as the sand-hills between Prince Albert and the Forks (about 1425 feet above the sea), and doubtless formed as dunes on the same old shore, beyond which, to the crossing of Sturgeon River, is a pleasant country with large prairie openings, and dotted with groves of poplar. Sturgeon River, where crossed, is a stream fifty feet wide and three feet deep, flowing swiftly in a channel ten feet deep. West of Sturgeon River bridge, thinly wooded sandy hills are again crossed for several miles, and then the road passes for twelve or fifteen miles over rich level alluvial land wooded with poplar, to the bank of Shell Creek, a branch of Sturgeon River. This stream winds in a shallow channel, in the bottom of a wide valley with gently sloping sides from fifty to a hundred feet high, and from half a mile to a mile and a-half apart. The level bottom-land is chiefly of sand or fine gravel and bears a close growth of short grass. The trail follows this bottom-land westward through three ranges of townships, and then turns northward, still keeping to the bottom of the same valley, which is here very wide. Old shore line. Shell Creek.

Shortly before reaching Sandy Lake, which lies to the west of Shell River, hills of loose sand and boulders begin to rise above the surrounding plain, and boulders begin to be scattered over the bottom of the valley. The hills are doubtless morainic, and the valley of Shell River, as well as others in the vicinity, were apparently formed by the water flowing from the face of the glaciers at the close of the glacial period. Morainic hills.

A few miles north of Sandy Lake, Shell River is crossed, in the middle of a wide sandy flat, at an elevation of 1700 feet above the sea. This sandy flat, apparently the bottom of a deep wide valley, is followed by the trail northward, along the east side of Devil's Lake,

Big River. to the crossing of Big River, at a distance of six miles beyond Shell River, and at an elevation of 1715 feet above the sea.

Old valley. Big River is here fifty feet wide, with a gravel bottom. It is said to flow into Crooked Lake a few miles below this ford, which lake discharges by Doré River into Beaver River—a tributary of Churchill River. The watershed between the Saskatchewan and Churchill rivers

Watershed. was therefore crossed on a sandy plain in the bottom of a deep valley running north-west and south-east. Big River enters the west side of this valley not far above the ford, but the valley continues on towards the north west for an unknown distance, its bottom being occupied by a series of shallow lakes. Beyond Big River ford, the trail keeps to the bottom of this valley for nine miles, until it rises to an elevation above the sea of 1850 feet. Then the trail leaves the valley and ascends its west bank, which has here a height of two hundred feet, beyond which, for five miles, are high sandy morainic hills, scattered

Summit on morainic ridge. with boulders. The highest point on the trail is in a heavy spruce forest in these hills, the elevation being about 2220 feet above the sea. Beyond these hills is a gravel plain at an approximate elevation of 2060 feet, through which Big River flows, in a beautifully terraced valley, half a mile wide and 180 feet deep. Its sides are steep and grassy, not strewn with boulders, and are apparently underlain by Pierre shales, but no scarped banks were observed, for the present stream does not appear to be eroding or deepening the valley to any appreciable extent. As the valley is ascended it becomes gradually shallower, not so much through the rise of the bottom as on account of the westerly slope of the country away from the high stony hills lately passed over. Finally it widens out into an extensive spruce and tamarack swamp, at an elevation of about 1900 feet above the sea, and only thirty feet below the surrounding country.

Leaving the valley at a small tributary creek, the trail for eight or ten miles crosses a rolling, bluffy prairie, underlain by a sandy till, with an elevation of about 2000 feet above the sea. The country

Sand-hills. then begins to have a definite slope northward, and rough, steep, sandy hills, thinly wooded with Banksian pine, make their appearance, and continue along the line of the trail for sixteen miles, in which distance the country has declined about 250 feet. These sand-hills do not seem to be morainic in character, but rather to represent one or more

old coast-lines on the shore of a great lake that extended away to the north in post-glacial times.

North of these hills a gently sloping even plain, wooded with poplar, spruce and balsam, and underlain by a slightly sandy clay, with very few boulders, extends to the edge of the valley of Green Lake.

Green Lake and Beaver River.

Old valley.

Green Lake is a narrow body of water eighteen miles long, lying at an elevation of 1440 feet above the sea. It nestles in the bottom of a valley two hundred feet deep at its southern end, and gradually shallowing to forty feet deep at its northern end. The sides are sloping and densely wooded with poplar and spruce. From the lake the valley extends southward an undetermined distance. The beach of the lake is largely composed of rounded transported boulders of granite, white quartzite, white limestone, &c. The depth of the water was not determined, but fishermen living in the vicinity report depths of from twenty to thirty fathoms, probably towards its northern end. The lake gets its name from the thick coating of floating green algæ which collects on the surface in the autumn.

Niobrara shale.

Foraminifera.

On the west bank, a short distance north of the end of the trail, typical calcareous Niobrara shale is scattered along the beach behind a line of small boulders, and at the edge of the grass a line of the same shale was found extending for about fifty yards, standing more or less on edge, as if it had slidden from the bank behind, and evidently not far from the parent rock. It contains a large number of foraminifera, including *Globigerina cretacea* and other forms found in the Niobrara of Manitoba, together with fragments of fish remains and of the thick prismatic shells of *Inoceramus*. On the beach in the vicinity were also a number of freshly broken fragments of lignite and nodules of ironstone, doubtless also derived from the Cretaceous shale of the bank.

Stratified sand, &c.

On the east shore, three miles north of the end of the trail, the bank is one hundred and fifty feet high, and thirty feet from the summit is a scarped face showing thirty feet of soft stratified sand. interbedded with fine sandy gravel with well rounded pebbles. Its exact relationships were not determined, but it is probably of glacial or post-glacial age.

Till.

Three miles and a-half further north and ten feet above the lake, is a scarp showing four feet of light unstratified till, composed largely of Cretaceous shale, but holding pebbles, some striated, of granite, white quartzite, vein quartz, limestone, ironstone, &c.

Green Lake River.

Green Lake River, a small sluggish stream five miles long and sixty feet wide, with reedy banks, connects the north end of Green Lake with Beaver River, the current sometimes running out of the lake and sometimes into it. A low grassy meadow extends on both sides of this river, underlain by ten feet, more or less, of stratified sand and clay. Beneath this clay is a bed of peat extending beneath the level of the water, and often containing large numbers of small fresh-water shells. Doubtless the stratified sand and clay is composed of material brought down from the west by Beaver River in times of high water, and spread out at the mouth of Green Lake.

Beaver River.

Beaver River rises more than 200 miles further west, in the vicinity of Lac la Biche, and flows eastward to the Green Lake River. Here it turns at right angles, assuming the course of the latter stream, and flows northward to the south end of Ile à la Crosse Lake. At first the banks are low and composed of stratified alluvial clay without boulders. The surrounding country seems to be a level plain, from ten to twenty-five feet above the river, and well wooded with poplar.

Hyper-Churchill Lake.

Banks of stratified sand soon begin to rise on both sides of the river to heights of forty or fifty feet, and the stream is broken by rapids over a bed of boulders. The surrounding country appears to be level or gently sloping northward, and the more sandy parts probably represent shore-lines of Hyper-Churchill Lake, the post-glacial lake that covered a great tract of country south of Churchill River. The banks again decline towards the mouth of Water-hen River, a considerable tributary from the west. They continue low and consist of clay for several miles, and then change to stratified sand and rise to a height of eighty feet, probably along another ancient shore. Just below this is the last and

Grand Rapid.

heaviest rapid on this portion of the river, known as Grand Rapid, with a fall of about twenty-five feet. The bed is of boulders, and the banks, about thirty feet high, are of dark-gray, slightly jointed, unstratified

Boulders.

sandy till holding pebbles and boulders. The boulders are chiefly of a rather fine-grained reddish granite, but very many are of green Huronian (?) rocks, a considerable number are of compact white Palæozoic limestone, one of which contained *Trochonema*, or an allied form; a few are of hard white quartzitic sandstone, two or three small ones of soft brown Dakota (?) sandstone, and one large slab of porous Cretaceous limestone containing *Cyprina subtrapeziformis*, or a somewhat similar species.

Below Grand Rapids, the stream flows with an easy and gradually slackening current, and boulders soon disappear from the banks, which are generally low and wooded with balsam poplar. However,

just above the mouth of Lower Doré River, a tributary from the east, cliffs of white and light yellow, well bedded, soft sandstone, probably of Dakota age, rise to a height of ninety feet on the west bank. On the top of the sandstone is a line of pebbles and boulders, over which is a foot or two of sandy till. No trace of fossils was found, and this sandstone is merely provisionally assigned to the age of the Dakota from its position near the base of the slope underlain by Cretaceous shales, &c., from its being overlain by a capping of till, and from its close similarity to many of the incoherent beds of Dakota sandstone in north-western Manitoba. Below the mouth of Lower Doré River the banks are generally alluvial, varying in height from twelve feet down to a low marsh, all but the latter being wooded with a beautiful growth of poplar. Occasionally we could see that we were winding through the bottom of a wide valley with banks about seventy feet high. Towards its mouth the river becomes a series of marshy lake-like expansions, with many of the points covered with boulders. Rounded hills of sand and boulders rise here and there, but no rock in place was seen.

Dakota sandstone.

Low banks.

Ile à la Crosse Lake.

Four miles from the mouth of Beaver River is Ile à la Crosse or Lacrosse Island. Its summit is a level sandy plain about forty feet above the lake, while its sides are steep and for the most part covered with coarse sand. At its south end, where the bank is but twenty feet high, the upper ten feet is a fine light-brown evenly stratified sand. At the north end of the island the beach is composed of small rounded boulders, about three-quarters of which are of red and gray granite, while most of the rest are of hard white and red sandstone. Some are of a soft highly ferruginous sandstone, probably of Dakota age, while a few are of Devonian dolomitic limestone holding *Atrypa reticularis*, &c. This sandy island is very conspicuous, as the surrounding shores are composed almost entirely of till. Its geological history was not clearly apparent, but it may represent a sandy delta deposit formed at the mouth of a super-glacial stream.

Lacrosse Island.

Two miles and a quarter from this island, on the west shore of the lake, is a large Roman Catholic mission establishment, and near it is the fur-trading store of the Hudson's Bay Company. These are built on a gentle slope of light-gray sandy till holding pebbles and a few boulders. More than half of the boulders are of hard white sandstone, indicating the presence of this sandstone in the immediate vicinity, though it was not seen in any natural outcrops.

Lacrosse mission and trading post.

Some ash-leaved maples had been planted in the garden of the Hudson's Bay Company's post, which are now from ten to fifteen feet high, quite healthy, and bearing abundant seed.

Dakota sandstone.

Five miles and a half north-west of the Mission, on the south-west shore of the lake, behind the beach of boulders, is a low outcrop of light-yellow, brown-weathering, friable sandstone, horizontally bedded, but often showing clear false bedding. It contains many small nodules of ironstone, and is overlain by a thin band of ironstone, mixed with a sandy clay shale. It contains many fragmentary remains of plants, now entirely carbonized. Although the geological age of this bed could not be definitely determined, it is probable that it represents some of the lower layers of the Dakota sandstone.

It is overlain by a cliff of soft sandy clay, with boulders, most of which are of gray gneiss, but some are of limestone, while others are of green trap, hard gray sandstone, fine conglomerate, etc. The land behind is moderately level and well wooded with poplar.

At Ile à la Crosse three canoemen were engaged for the summer, and on the 29th of June, 1892, we started northward.

Ile à la Crosse Lake.

Ile à la Crosse Lake extends northward from the Mission for thirty-nine miles. For the first twenty-nine miles we followed its west shore, which is generally low and indented by deep bays, the beach being of sand or boulders. The east side is much straighter, and rises in a high wooded ridge parallel to the lake. This ridge is said not to be sandy, but to be composed of clay and boulders, and the thick forest covering it would confirm this statement.

East shore.

At the end of the above distance is a long gravel point, from which we crossed the lake, here only about a mile and a-half wide, to the east shore, which was found to be composed of gravel and boulders, almost all of granite, though some are of sandstone. None of limestone could be found, indicating that we were now further north than the edge of the possibly underlying limestone. The country behind the east shore is here generally low. No rock in place was seen around this part of the lake.

Churchill River.

From the north end of Ile à la Crosse Lake, Churchill River flows eastward as a rapid stream from fifty to seventy yards wide, over a bed of boulders, with low banks of sandy till. Below this rapid the river opens into Shagwenaw Lake, a beautiful sheet of clear water, dotted with many wooded islands.

Shagwenaw Lake.

For seven miles below this lake, the river is wide and deep, with a gentle current. The banks are low and wooded to the edge of the water, or overgrown with grass and sedge, except at some of the points where there is a bare string of boulders. Below this quiet water are three rapids, with descents respectively of about six, eight and five feet. The banks throughout are low and of till, and the beds of the rapids seem to be entirely of boulders, no rock in place being visible.

Mudjatick River.

Mudjatick or Bad Cariboo River, rises in several small lakes and streams in the low rocky country a short distance north of latitude 57°, and flowing almost directly southward for eighty miles, empties into Churchill River, thirteen miles below Ile à la Crosse Lake. For most of the course it flows in a shallow winding channel between level banks of stratified sand. Rocky hills may be seen on both sides, but they seldom close in on the river, and the stream is obstructed by but few rapids, and most of these are caused by accumulations of boulders. Rocky hills

Up to the date of the present exploration nothing was known of it beyond what is indicated on the face of Sir John Franklin's map of 1819 and 1820, by the following note: "Stated to afford a passage to the Athabasca Lake by crossing a height at its source."

On the 1st of July, 1892, we entered the mouth of the river, which was then at extreme high water, and began the toilsome ascent of its rapid current. The water was up in the willows, which almost everywhere overhung the channel, so that it was impossible to track the canoes with a line from the banks. Poling was also out of the question since the bed of the channel is composed of shifting quicksand. It was, therefore, necessary to ascend entirely with paddles, keeping close to the banks, and occasionally clutching the low bushes. Each time that we were obliged to cross the winding channel in order to avoid the rush of the current on the outer sides of the bends, we were swept back further down the stream. In lower water, when many of the sand-bars would be dry, the river would probably be easy to ascend, but then its upper stretches might be too shallow to permit of the passage of a large canoe. High water

Three miles up the stream, or just above the mouth of a brook flowing through the hills to the west, the river flows for a mile near the foot of some ridges of rather fine and even-grained red biotite-granite gneiss, which rise to a height of from thirty to a hundred feet on the east side Ridges of gneiss.

of the valley, and extend towards Churchill River in a direction S. 15° E. Their surface is generally somewhat rough and weathered, but many of the higher points are beautifully smoothed and polished and show fine, but well marked glacial striæ, trending S. 15° W. The direction of glacial motion is shown by the rounding down of the southern sides of many little pits; while at the same time the north-east sides of the hills are rounded and the south-west sides are broken and strewn with fragments of rock.

Glacial striæ.

Two miles above the last and highest of these granite hills, a portage is stated to run eastward to a lake which connects with Churchill River. The Indians often use this route to avoid the laborious ascent of the lower part of the river.

Sandy plain.

A short distance above this portage, on the west bank of the river, is a grove of Banksian pine on an open sandy plain, forming the first pleasant piece of dry land that we had seen since leaving Churchill River. From this grove to Bear Rapid, the river flows with an even current of about four miles an hour, through willow covered flats, with here and there groves of open pine woods. No rock could be seen from the canoe.

Bear Rapid.

Bear Rapid is a swift chute with a fall of about two feet, past which is a portage track, one hundred yards in length, on the west bank. The rapid is probably caused by a ledge of smooth rock crossing the channel, but the water was so high that none could be seen.

Above Bear Rapid, the river continues to wind through a sandy plain to the foot of a series of rapids caused by accumulations of boulders in the bed of the channel. Boulders are also scattered in considerable abundance over the flats on both sides of the river, though very few or none were seen below this point. At some places the boulders are piled in long ridges, which probably represent a moraine formed by the last glacier that extended southward in this region. The rapids are four in number and extend for two miles and a-half, but none are so impetuous as to render it impossible to track the canoes up them with a stout line.

Probable moraine.

East of the lowest of these rapids is a ridge of red biotite-granite, including lenticular masses of well foliated gneiss. One isolated boss was composed of dark gray, fine-grained, highly hornblendic gneiss, associated with a fine-grained diorite charged with sulphides.

West of the uppermost of the four rapids is a more or less rounded boss, thirty feet high, of dark, green, fine-grained, highly altered trap.

A mile further north, on the east bank, and at the north end of a ridge of sand, is a small outcrop of whitish quartzite striking N. 85° E., and with an almost vertical dip. This quartzite is very highly charged with pyrrhotite, and the compass was strongly deflected towards it. Quartzite.

A mile and a-half further north, a rounded hill fifty feet high rises on the west side of the river, composed of light-gray granite-gneiss, cut by many veins of red pegmatite. From the hill a long sand ridge stretches away in a direction S. 20° E. A boss of similar gneiss, a mile further up the stream, shows a fine foliation striking N. 80° E., while on a smooth surface close to the water, glacial groovings are beautifully shown trending S. 20° W.

Above this hill the stream for several miles winds through a sandy plain, cliffs of stratified sand from thirty to forty feet in height appearing on the banks.

Old Wives Rapid occurs at a sharp curve in the stream as it passes through a narrow gap in a granite ridge. A portage over a scrubby ridge leads past it on the west side, but it was possible to haul our canoes up the rapid with a long line. Old Wives Rapid.

Among the boulders scattered over the surface here, are a few of white Athabasca sandstone, which have been transported from the north, and have apparently been derived from the sandstone area lying north of Cree Lake.

The adjoining hills rise to a height of about 130 feet, and are composed of a red, highly felspathic granite-gneiss, foliated in a direction S. 80° E. The tops of the hills are weathered so that no striæ could be detected, but there were many short grooves trending S. 20° W., and on the face of the hill, near the edge of the water, are polished glaciated surfaces showing grooves trending in the same direction. Hills of gneiss.

For the next eight miles the river has an average width of about 200 feet, an average depth of six feet, a current of about five miles an hour, and passes between high sand ridges trending in a general north-and-south direction. At the north end of each ridge there is usually a boss of whitish mica-diorite-gneiss, but the sand rises above it, and the highest point of each ridge is south of the rock. Small poplar and birch trees are growing by the river, and the hills are wooded with Banksian pine. At the end of this distance is a portage forty yards in length, across a dry sandy ridge, wooded with large pines. This portage is made to avoid a long bend of the river, into which Porter Creek is Sand ridges.

said to empty. This creek was stated to flow from Porter Lake, which lies six or seven miles east of Mudjatick River.

Heddery Creek.

A mile and a half above this portage, Heddery Creek, a stream twenty-five feet wide, with a swift current, flows in from the west, and is said to rise in Heddery Lake.

Whitish mica-diorite-gneiss.

Above the mouth of this creek is a rounded hill eighty feet high, of whitish mica-diorite-gneiss, very irregularly foliated, but with a general trend east and west.

The river continues in a depression between hills of this gneiss for the next four miles, and then the hills fall away on either side, and it traverses a sandy plain in a valley which gradually increases to a depth of 100 feet. The bed of the river is sand, without boulders, but a few boulders may occasionally be seen on the surrounding plain, many of them being white Palæozoic sandstone. Poplar has now almost entirely disappeared, a few trees of black spruce and tamarack are growing by the river, but the banks and uplands are wooded with pine.

In latitude 56° 35′, hills of gray biotite gneiss rise above this sandy plain, and in latitude 56° 38′ the river sweeps against the eastern side of a hill of reddish-gray, highly biotitic gneiss, well foliated and striking N. 20° E. The surface shows a number of strong glacial grooves, trending S. 50° W.

Grand Rapids

A mile and a-half north of this hill, we reached the foot of the Grand Rapids, where the water falls eight feet over a ledge of gneiss, broken into two steps. A portage, ninety yards in length, over a sandy flat, runs past it on the east side. The rock is a gray biotite-granite-gneiss, well foliated, striking N. 15° E., and dipping at a high angle to the east. A quarter of a mile above the portage is a long rapid over rock and boulders, with a fall of six feet, past which we tracked the canoe with a line on the west side. Above Grand Rapids the river, now about thirty feet wide, flows from a moderately well defined valley,

High sand banks.

about a quarter of a mile wide, the banks of which are often a hundred feet in height, very steep, and composed largely of sand, through which are scattered a few boulders and pebbles, all of the latter being water-worn. The surface above is undulating, rising into hills about 200 feet above the river.

Three rapids.

In this valley are three rapids, the lowest of which has a fall of five feet, over a ledge of gray gneiss with a general strike N. 25° E. An almost vertical cliff of gneiss rises on the east side. The middle rapid

is very similar in character to the first, past which there is a portage ninety yards in length on the west side. At the third rapid the river falls three feet over a ledge of gray gneiss, while a portage sixty paces long leads past it on the east bank.

At a bend in the valley, a mile and a-half above the last rapid, Girard River, a swift, shallow stream fifty feet wide, joins the main stream from the east. Girard River.

On the west bank, above the mouth of Girard River, and behind a sandy plain, rise rounded hills of medium-grained dark reddish-gray biotite-granite-gneiss, often intricately folded in with a coarse red granite.

The river flows through the pine-covered sandy plain up to the Forks of the Gwillim and Mudjatick rivers, where the two streams run together from opposite sides of a long sandy point, the former being forty and the latter sixty feet wide. On the west bank at the forks is a bare hill of fine-grained, red biotite-granite-gneiss, striking S. 15° E. and dipping N. 75° E. at an angle of 60°. The surface, close to the edge of the water, is well glaciated, striæ trending S. 20° W. Gwillim River.

The Mudjatick River is said to flow from the north-east, passing through three small lakes in its course.

The country now becomes more level and swampy, and the streams are interrupted by lakes and stretches of quiet water. More level country.

At the Forks, we left the main stream and entered the Gwillim River, which flows for eight miles from a north-westerly direction, passing the mouth of Ithingo River about the middle of the distance. For four miles it winds through a level marshy plain, surrounded, at a distance, by high rocky hills. The banks are often low and ill-defined. Near the mouth of Ithingo River, sandy hills, or a high sandy plain, approaches on both sides; but still the bottom of the valley is marshy, with many abandoned river-channels, and the sluggish stream, fringed with yellow water-lilies, extends up to Little Sandy Lake, which is surrounded by high wooded sandy hills. On the evening of July 8th we camped in open pine woods at the north end of this lakelet, a lovely sandy beach extending before our tents. Ithingo River. Little Sandy Lake.

One small, bare, rocky island rises out of the centre of the clear water of the lake, consisting of a dark-gray, thinly foliated granite-gneiss striking N. 45° W. and dipping at a high angle, S. 45° W., interbedded with a light-gray coarse-grained garnetiferous biotite-granite-gneiss. Rocky island.

In the river, three-quarters of a mile above the lake, is a small island of similar highly garnetiferous gneiss.

A short distance above this island, the river turns almost at right angles towards the north-northeast, and the valley, which has been narrow and deep from the lake, becomes wide and more diffuse. The wide stretch is two miles and a-half long. Near its northern end the west bank of the stream is overhung by a high rugged cliff of gray granite-gneiss, interlaminated with bands of highly ferruginous and quartzitic gneiss. In general the lamination is nearly horizontal, but in detail it is much contorted.

Cliff of gneiss.

In north latitude 56° 53′, the valley turns sharply eastward and bare cliffs of sand rise to a height of eighty feet on its northern side. The valley maintains this eastward direction for two miles, gradually decreasing both in width and depth, while both the hillsides and the bottom of the valley become covered with boulders. The stream is thirty-five feet wide, with a current of three miles an hour. From the end of this stretch the river again turns to a north-northeasterly direction through low land, to the south end of Gwillim Lake.

Gwillim Lake.

Gwillim Lake is a pleasant open body of clear water lying in a north-and-south direction, with a greatest length of five miles and a-half and a greatest width of a little more than a mile. The eastern shore is generally low and sandy, though behind an abandoned trading post of the Hudson's Bay Company are some rather high lightly wooded hills that seem to be covered with boulders. Behind the western and north-eastern shores are somewhat prominent hills of gneiss.

The Gwillim River flows into the north-western end of the lake, but the canoe-route leaves the lake at a low sandy beach at its northern end, and our canoes were carried for 300 yards on a sandy plain through open woods of small Banksian pine, to the bank of the narrow winding stream.

Variation of the compass.

At this portage the compass was found to have a variation of 27° east.

Crooked stream.

Above Gwillim Lake, the diminished stream is very crooked, winding at first between low sandy willow-covered banks, through swamp thinly wooded with spruce and birch. The banks gradually rise to heights of thirty feet, being composed of stratified sands, and at the end of two and a-half miles, measured in a direct line up the valley, the river is broken by a rapid over boulders, in which there is a total drop of about fifteen feet. Past this rapid is a portage on the

Sand banks.

west side 230 yards long. The portage is through thin woods of small Banksian pine, and over a slight sandy knoll strewn with boulders, some of which are of white sandstone, probably of Athabasca sandstone. From the top of this knoll the river is seen to flow in the bottom of a rich but rather shallow trough, with rocky sides, extending northwards towards Solitude Lake. South of this knoll is the point of a hill 100 feet high, composed of a coarse, red biotite-gneiss with undulating vertical foliation striking S. 20° E. The sides of this hill are also strewn with boulders.

Solitude Lake, a mile and a-half north of this portage on the same stream, is a rounded body of clear water a mile and a-half in length with low even wooded shores, in front of which are occasional stretches of sandy beach. No boulders, or rock in place, are seen anywhere around it, but in the background are high rounded hills covered with forest. The canoe-route traverses the lake to its northern end, where the canoes and goods are landed. They are then carried by a portage 150 yards long in a north-northeasterly direction, over a sandy plain wooded with small Banksian pine. This portage cuts across a long bend of the river, reaching it at a point where it has a width of about twenty-five feet. Solitude Lake.

From Solitude Lake the river was followed in our canoes northward for three miles, as it wound in a very tortuous channel ten to fifteen feet deep, across an almost level plain of fine white sand covered with light green lichen, and thinly wooded with small Banksian pines. At one point some low, rounded, rocky hills rise above the west bank, consisting of rather coarse, rusty, reddish-gray hornblende-gneiss, irregularly foliated. Strike S. 75° E. Plain of fine white sand.

At the end of the above distance, Gwillim River, which continues to flow from the north-northeast, was left, and the canoes and goods were carried for a mile in a north-westerly direction over the level sandy plain by the south bank of a small tributary brook. Near the west end of the portage the country begins to rise a little, and the brook, here from five to eight feet wide, flows swiftly in the bottom of a valley twenty feet deep. Leave Gwillim River.

At the west end of the portage is a lake, a third of a mile in diameter, with water of a light-brown colour, and low weedy shores, behind which are sand-hills thirty to forty feet in height. This small lake, in north latitude 57° 7′, and west longitude 107° 29′, and with an elevation of 1650 feet above sea-level, lies just south of the watershed between the drainage basin of Churchill River, and that of Lake Small lake.

Watershed. Athabasca. From it a portage 200 yards long leads up a steep sandy slope forty feet high, across a sandy ridge, and into a basin-shaped depression fifty feet deep, in the bottom of which is a small lake of clear blue water, without outlet.

Height-of-land portage. This lake, a little more than a quarter of a mile in width, was crossed in canoes to the southern end of another portage, 1100 yards long. The path ascends a slope fifty feet high at one end, and descends a similar slope at the other. In the middle it is over an irregular country, with deep basin-shaped depressions and high hills, composed Sand-hills. of moderately fine, white sand, without pebbles or boulders. The north end of the portage is in a small grove of Banksian pine at the south end of a lake of clear water which discharges northward towards Cree Lake and Stone River. Thus the two last portages cross the height of land, but no rock in place was seen in the vicinity or nearer than the granite knolls on the west bank of Gwillim River.

Cree River and Lake.

The lake north of the height of land lies among wooded sandy hills a hundred feet in height. On the morning of July 13th the party left camp among the pines at the south end of this lake, and travelled Small lake. north-eastward for two-thirds of a mile across the lake to a marsh, over which the canoes were dragged for a hundred and fifty yards to a small stream, which was descended a quarter of a mile between banks fringed with yellow water-lilies, to another lake with low marshy shores, wooded with small spruce, larch and Banksian pine. It lies in a north-westerly direction, and is a mile and a third in length. From its north-western end flows a winding stream thirty feet wide, and five feet deep, with a current of two miles and a-half an hour, between low marshy banks, at first well defined, but afterwards very irregular and broken. After flowing eastward for two miles and a-half, the river Hill of boulders. runs along the north side of a hill composed of large boulders of red granite-gneiss, while on the opposite side of the valley is a ridge of apparently similar gneiss in place. For the next two miles and three-quarters, the river is wide and indefinite, in the midst of an extensive marsh. On a low wooded ridge composed of sand and rounded pebbles, many of which are of white sandstone, the latitude was found to be 57° 10′ 51″. The sides of the valley are steep escarp- Sandy terrace. ments of sand, rising to a sandy terrace eighty feet above the river, at about the same altitude as the summit of the height-of-land portages.

In latitude 57° 11′ 30″ the valley contracts and the river flows between high cliffs of red biotite-granite-gneiss striking N. 65° W. The

highest points of the surface are polished and faintly striated in a direction S. 70° W.

After passing through this rocky gap, the river enters an open basin, on the sides of which are sand terraces rising twenty-five feet above the water, and a mile and a-half north of the gap it passes between a number of low boggy islands into Cree Lake. Many large fresh-water sponges (*Meyenia fluviatilis*, Linn.) could be seen through the clear water growing on submerged twigs and sticks beside these islands. Cree Lake.

Cree Lake is a large elongated body of pure transparent water lying in a general north-east and south-west direction, with a greatest length of forty-nine miles and a width as yet undetermined, but sketches obtained from Indians who had travelled round the lake, would indicate that it has a total area of about four hundred square miles. The soundings taken in open water along the line of travel, gave depths varying from fifty-five to a hundred and fifty feet. The altitude of the surface, as determined by numerous aneroid readings, is 1530 feet above sea-level. The temperature of the water in the open lake on July 14th was 53° F. Area.

The course followed from its southern extremity to its outlet near its northern extremity, was generally along its west side, and the following description applies exclusively to the country seen on this line of travel. Course followed.

From the mouth of the river, a bay about a mile and a-half in diameter, is crossed in a northerly direction, to a strait a hundred yards in width between steep sandy hills. The surrounding country is composed chiefly of low rounded hills of sand, with occasional points of a rather coarse, reddish-gray gneiss. Sand-hills.

Our first camp on the shore of the lake was pitched a mile east of this strait, at the foot of a hill of coarse gray gneiss, that rises to a height of 120 feet above the water. On the top of the hill is a large boulder of gneiss seven feet long, the southern side of which is perched on a smaller boulder. Under it glacial grooves are strongly marked, trending S. 35° W. Many of the other boulders around the hill are of white sandstone. Since the hill is the highest in the vicinity, a magnificent view may be had from its summit, of the lake and the surrounding country. From east to south, wide sandy plains, wooded with small Banksian pines, stretch away to the limit of vision. In other directions the country is composed of gently rounded Hill of gneiss

Surrounding country.

hills wooded with small pines, with occasional sandy escarpments facing the lake. The lake shore is very irregular, and six small wooded islands break the surface of the blue-green water. A few small scattered trees of white birch grow by the shore, but no poplar had been seen since leaving Solitude Lake.

The variation of the compass was here determined at 25° 30′ E.

Islands. A mile and three-quarters north of this camp is a group of three small wooded islands, the most southerly of which is composed of a rather coarse, gray, highly felspathic biotite-gneiss, with, in places, a moderately well marked sinuous foliation striking S. 55° E. Part of the island is covered with till, consisting of sand and boulders, many of which are of sandstone. The surface of the gneiss is smoothed, and shows glacial groovings trending S. 25° W.

Three miles and three-quarters in a direction N. 36° E., over open water averaging 110 feet deep, across the mouth of a deep bay, is a point on the west shore, behind which is a hill 120 feet high, the south Hill of gneiss. side of which is composed of gneiss very similar to that seen on the island, while the top and east side are composed of sand and boulders. The lake here contracts to a width of about three-quarters of a mile, and behind the eastern shore is a hill, formed, apparently, of gneiss. These hills of gneiss, on both sides of this strait, appear to form part of a ridge that runs N. 65° W. across the country, and they were the last exposures of Archæan rock seen, on this line of travel, south of the northern shores of Black and Athabasca lakes. Between these two places the country is underlain by Athabasca sandstone. Cree Lake, therefore, adds one more to the list of the large bodies of water which, in Canada, lie along the line of contact of the comparatively unaltered Palæozoic and the highly altered Archæan rocks.

Northern limit of Archæan rocks.

For the next two miles, the west shore is low and is protected by a wall of rounded boulders, beyond which our course turned north-westward to the north shore of a low island, wooded with black spruce and birch, the point of which is piled six feet high with boulders of white sandstone. A meridian altitude of the sun observed here gave the latitude as 57° 19′ 30″ north.

A mile and three-quarters across open water brought us to a long low point of land surrounded by boulders of sandstone. South of this line high cliffs of sand were seen to skirt the shore. About the middle Deepest sounding. of the distance, a depth of 150 feet was found, being the deepest sounding obtained in the lake, though perhaps the water may be much deeper farther from land.

From this stony point we again crossed the mouth of a bay about five miles deep, in a direction N. 45° W., past several islands apparently of till, to the west shore of the lake, where a cliff of light red Athabasca sandstone rises twenty-one feet above the level of the water. The sandstone is horizontally stratified in beds varying in thickness from two to six inches, and often shows distinct false-bedding. It is not very compact, and quite unaltered, and the individual quartz grains are moderately well rounded. Some soft calcareous spots have possibly been fossils, but they now show no trace of structure. The surface of the rock is polished and marked by distinct glacial striæ trending S. 35° W. Athabasca sandstone.

From this cliff the shore was followed northward for a mile and three-quarters, past some low cliffs of sandstone, and points surrounded by boulders, to the bottom of a bay where camp was pitched, in heavy rain, on the evening of the 14th of July, on a level sandy plain thinly wooded with small Banksian pines.

A third of a mile north of camp is a narrow elongated hill or ispatinow 120 feet high modified by subsequent wave action, with its longest diameter stretching S. 35° W., parallel to the glacial striæ in the vicinity. Its summit, which is rounded and from thirty to sixty feet in width, is composed both of rounded and more or less angular cobbles or fragments of sandstone imbedded in sand or rock-flour. It rises from the level of the plain to the south-west, and then undulating slightly for two hundred yards, drops more suddenly again to the plain. The north-west side slopes to a valley, beyond which is another similar ridge, while in the distance are others, probably also of a similar character. The south-west side is rather abrupt. Ispatinow.

The two ancient shore-lines, marked by the sandy terraces south of the lake, are also distinctly shown on the side of this ispatinow. On approaching the hill from camp a gently rising sandy plain is crossed, until a compact pavement of large sandstone boulders is reached, with a scarp six feet high behind it. The foot of this scarp, marking the height of the lowest old shore line, is forty feet above the present level of the lake. Above this scarp the slope is steeper and is rather thickly strewn with boulders. At a height of seventy feet above the lake, a line of well rounded cobbles marks another distinct shore. It is best shown at the north-east end of the hill, round which it curves as an arched beach-ridge of water-worn pebbles. Ancient shore lines.

No signs of the upper shore-line at approximately the same altitude were seen around any of the many hills farther north. There is no Hyper-Cree Lake.

land in that direction sufficiently high to form the northern shore of a lake seventy feet above the level of the present lake, and there seems to have been very little warping of the crust since the glacial times. It would therefore seem moderately certain that we have here portions of the ancient shore-line of a lake that lay between the front of the Keewatin glacier not very far to the north and the higher land to the south. At its highest stage it must have discharged over the height of land south of Cree Lake, the ancient river flowing down the wide valley in the bottom of which now winds the Mudjatick River.

From the camp near the foot of this hill, we paddled S. 30° E. for a mile, to a low point, and then for a mile and a quarter eastward across the mouth of a deep bay to another low point, piled around with an ice-shoved wall of sandstone boulders five feet in height.

Shore of boulders.

From this point north-eastward, the north-west shore of the lake is generally thickly strewn with boulders, with occasional low hills of boulders a short distance inland. At a place where we stopped for lunch in north latitude 57° 25′ 00″ a grove of large Banksian pines covers a sandy plain in front of a hill of boulders, and under the trees were growing many flowers of the beautiful ladies' slipper (*Cypripedium acaule*, L.), calling to mind the lovely woodland glades then far to the south. Half a mile farther north, a hill 150 feet high rises from the edge of the water. The central portion of the hill consists of a dyke about two hundred feet wide, of a coarse light green uralitic diabase, apparently running S. 65° W. Examined microscopically, this rock is seen to consist of plagioclase, much of which is altered to calcite and sericite; hornblende, which has probably resulted from the decomposition of augite, and some of which is altering to chlorite; biotite in small amount; quartz in granophyre structure; and ilmenite, altering to leucoxene.

Diabase dyke.

Altered Athabasca sandstone.

The hill is thickly covered with boulders, but near its summit, about twenty feet of highly altered pinkish Athabasca sandstone is exposed north-west of the diabase dyke. It dips at an angle of four degrees away from the dyke, and becomes less altered as it recedes from it.

The canoes here left the shore and struck out into the lake in a north-easterly direction among a number of high thinly wooded islands which, seen from the end, appear as sharply pointed cones rising from the water, and seen from the side as diffuse domes. One of these islands, at a distance of three miles and a-half from the trap dyke, was named Prospect Hill. It is a narrow hill rising to a height of 170 feet above the lake, and as a depth of seventy feet of water was

Prospect Hill.

found not very far from it, it may be said to have a total height of 240 feet. It trends N. 35° E., parallel to the direction in which the glacier last moved across this region. The summit is nearly level for a width of a hundred feet, the sides are as steep as the earth will stand, while the ends round down easily to the shore. As far as can be seen it is composed entirely of sand and boulders, without rounded gravel. It shows no sign of stratification or of being composed of well waterworn material, but consists rather of loose, unassorted till, and like the hill near the last camp, and hundreds of other similar hills around and farther north, it is a typical example of the elevations described on page 23 as ispatinows.

View of Cree Lake.

From the top of Prospect hill a beautiful view may be had of the lake and the surrounding country. Toward the north-west, a wide almost open plain stretches away towards Whitefish Lake. Cree Lake is seen to be studded with thinly wooded islands, all apparently of the same nature, more or less oval in shape, and rounding up from each end to a highest point near the middle. All lie in the same direction parallel to the course of the last glaciation, and none show any outcrops of the underlying rock. These ispatinows are seen to be more numerous on the lower areas, now covered by the water of the lake, than on the surrounding higher land. In the absence of any sections, and on the hasty examination which the writer was able to make, it is very difficult to determine the exact mode of formation of these hills, but the conditions that seem to have prevailed at the time of their formation may be here briefly stated. The glacier, spreading out from a great gathering-ground in the vicinity of Yath-kyed Lake, was here moving south-westward, parallel to the long axis of Cree Lake. Its front had receded from the Archæan rocks to the south, and was, therefore, some distance north of the present height of land, and its foot was washed by Hyper-Cree Lake, whose strands are so distinctly marked around the southern end of Cree Lake. Towards its front this gradually retiring glacier would be much reduced in thickness. Streams would flow on its surface, but when these streams plunged into the narrow crevasses or moulins the water would at once reach the level of the adjoining lake, the current would cease, and the material carried by the stream would accumulate in one place between the narrow walls. As the walls melted away these accumulations would thus remain as narrow elongated ridges of unassorted material, without any external sign of stratification. The above explanation of the formation of these high ispatinows between narrow walls of ice, in quiet water, would seem to apply throughout the north wherever these hills were seen, while where the water from the glacier had a free course

Ispatinows.

Conditions of formation.

towards lower ground, ridges of this character do not seem to have been formed, and where the water flowed freely between icy walls, eskers were produced, some magnificent examples of which may be seen in the country further north.

Four miles north-east of Prospect Hill, camp was pitched on the east side of a thinly wooded sandy island, at the foot of a similar hill, sixty-five feet high, the summit of which was thickly strewn with boulders of sandstone. The variation of the compass at this place was determined as 26° 30′ east.

The next morning the journey was continued in the same north-easterly direction, across the lake, between the numerous islands, on many of which rose similar narrow hills. At about nine miles (in N. latitude 57° 25′ 9″) we stopped for lunch at a rather high point of a large island, behind which is a hill of loose sand sixty feet high, with a few boulders scattered over its sides and summit. Beyond it are other similar hills, with basin-like depressions among them. Similar hills again stretch away to the north-eastward and form islands in the lake. They have very much the appearance of being wind-formed dunes.

Sand-hills.

From this point we paddled in a direction N. 10° E. for two miles and a-half across open water, to the west shore, at a point piled with boulders of sandstone. The greatest depth of water found when crossing the lake here was 120 feet. The character of the country had now changed, the ispatinows and numerous islands having been left behind; but low stony ridges were still to be seen, the land rising in a moderately regular slope to a height of about eighty feet above the water. This gradually declines to the north-eastward to a height of forty feet. The shore in front of this slope is irregular, with low stony points. The lake here contracts to a width of about half a mile, but whether the east side of the narrows is a large island or the main east shore was not determined.

Low stony ridges.

On the west shore, at the north end of the strait, there is an exposure above the edge of the water of three feet of thick-bedded soft white Athabasca sandstone. The principal lines of stratification are horizontal, but in places a false-bedding can be detected. The surface is smoothed and shows glacial grooves trending S. 15° W. This is the third and last exposure of sandstone seen on Cree Lake, but the general appearance of the adjoining country would indicate that it is all underlain by similar rock.

Athabasca sandstone.

Four miles N. 25° E. from this sandstone outcrop, and a mile south-west of the outlet of the lake into Cree River, we camped on a sandy

plain among thin woods of Banksian pine, though behind the camp was a low rise thickly strewn with boulders. Among these are many of reddish garnetiferous and gray gneiss, and of compact green Huronian (?) schist. No boulders of limestone had been seen since leaving Churchill River. The sand on the beach here is composed of well-rounded grains of quartz of very regular size. When walked on it emits a sharp ringing note. A meridian altitude of the sun observed here gave the latitude at 57° 42′ 30″. Boulders. Musical sand.

Where the Cree River flows from the north end of Cree Lake it is about 200 yards wide, with sandy bottom, and low banks wooded with small Banksian pine and spruce. The stream soon becomes very rapid, with a current of from six to eight miles an hour over a bed of broken fragments of sandstone. Six miles below the lake we reached the head of a long rapid, known as Hawk Rapid, in which the river has a total descent of from thirty to forty feet in a distance of about two miles. Near the head of the rapid a small exposure of white horizontal sandstone is seen on the east bank, while the low plain to the north-east is composed almost entirely of rough masses of this sandstone. Half a mile farther down, on the same bank, is an escarpment showing ten feet of horizontally bedded, hard, coarse-grained sandstone, of a light salmon colour. Its surface is well polished but without glacial striæ. Just below it, is a cliff thirty feet high of unstratified till, holding a large number of boulders of sandstone imbedded in a matrix of sand. Very few boulders of gneiss and none of Huronian rocks were present. Half a mile further down, the river rushes in a wild torrent between abrupt walls of sandstone ten feet in height, and around the vertical or overhanging sides of Hawk Island, which stands up in the midst of the foam. The sandstone is coarse-grained and well stratified, white on fresh fracture, but weathering to a light brown colour. Above the sandstone is a cliff of till twenty feet in height, rising to the level of the surrounding country. The flood-plains of the river near the rapids are composed of rough broken masses of sandstone, up to a foot in diameter. Cree River. Hawk Rapid. Athabasca sandstone.

The rapid is a long and bad one, without any channel. It cannot be tracked with a line and wading in the water is very difficult on account of the swiftness of the current, the sharpness of the stones, and the irregularity of the stony bars. Paddling is generally impossible, and it is difficult to obtain a proper set for the poles, as they slip down and catch between the large stones. On this account the Indians rarely ascend this river, our Chippewyans telling us that but one man had ascended it in the past seven years.

One of the canoes had been badly broken in the rapid, and the men's feet and legs were cut with wading over the sharp stones in the water. Canoe broken.

We therefore camped a mile below the rapid, among scattered Banksian pines on a sandy plain on the west bank of the river. Some low hills in the vicinity are covered with boulders. Into the bottom of a little bay near the camp a small stream, twenty-five feet wide and three feet deep, with a current of a mile an hour, flows from the south-west.

For several miles below the mouth of this brook, the river at times expands into wide quiet stretches, and then rushes down heavy stony rapids, flowing through an undulating sandy country. At a distance of eight miles below the brook and about a mile below a sharp bend to the west, six feet of similar pink horizontal sandstone is exposed on the west bank. A short distance below this sandstone, the lightly rolling sandy country is left behind, and the now uneven surface rises in irregular morainic hills of boulders a hundred feet in height. On the sides of these hills some small aspen poplars grow, the first that had been seen north of the height of land. These morainic hills continue for a short distance, and then the more sandy country is again entered.

Morainic hills.

For twenty miles the heavy rapids succeed each other in quick succession. They are all very similar in character. The stream first becomes very narrow and swift, often with a current of ten or twelve miles an hour, and then gradually expands, until it is spread thinly over a wide bed of gravel and boulders, over which it is almost invariably necessary to wade, and grasping the canoe by the gunwales, lift it slowly along. The river nowhere flows in a deep valley, though the banks are mostly composed of easily ercsible sand and sandy till, which would be quickly carried down by the impetuous current. The reason that at once suggests itself for the absence of valleys in this, as well as in most of the other rivers in the far north, is that the ice sheet has but comparatively recently retired, leaving the surface free to be remodelled by the streams that now flow over it; but it must be borne in mind that the streams are frozen over for most of the year, and when the ice breaks up in early summer it shoves the boulders and loose masses of rock into compact boulder walls and pavements in the bank and bed of the stream, forming surfaces that resist stream erosion almost as effectually as the solid rock itself.

Character of rapids.

Absence of valley.

Reason of such absence.

In north latitude 58° 00′ 00″ a low exposure of similar stratified sandstone may be seen on the west bank near the foot of a rapid, and in latitude 58° 5′ 30″, cliffs six feet high, of precisely similar coarse sandstone form the east bank. Midway between these two outcrops, rounded hills of sand, from fifty to eighty feet high, rise on each side

of the river, probably representing dunes on an ancient shore of Hyper-Black Lake. Just below the lower cliff, Little Cree River, a stream of brownish water, with a strong current, joins the main stream from the south-east, its mouth being hidden by many low wooded islands, which here break the Cree River into numerous swift shallow channels. After a long and hazardous day of incessant toil, camp was pitched on the evening of July 19th on the east bank, two miles below the mouth of Little Cree River, at the foot of a low sandy terrace. A meridian observation on Altair gave the latitude here as 58° 8′ 00″. Ancient dunes. Little Cree River.

The next morning, we had been in our canoes but a few minutes when we were in the middle of a deep heavy rapid three-quarters of a mile in length, at the bottom of which sandy terraces rise on both banks to heights of forty feet above the river. Nine miles below camp, at the foot of a similar rapid, the terrace is still forty feet high, and meagrely wooded with small Banksian pines. A scarped face shows it to be composed of stratified sand. The surrounding country consists of rolling stony hills, the angular masses of rock, so prevalent higher up the stream, being no longer seen. Sand escarpments.

From the sand escarpments, the river takes a very straight general course in a north-northeasterly direction, between low marshy banks in the bottom of a valley a third of a mile wide and forty feet deep. At the foot of this straight course, and a quarter of a mile above the mouth of Rapid River, a meridian observation of the sun gave the latitude as 58° 18′ 22″. Rapid River is a swift shallow stream, seventy feet wide, flowing from the east. Rapid River.

Two miles and a-half below the mouth of Rapid River, low cliffs of peat rise on the west bank of the river, below which the banks are flat for a couple of miles. Then begins a series of heavy, though moderately deep, rapids, separated by stretches of quiet water. Much of the surrounding country is a sterile sandy plain, varied with equally sterile hills of boulders. Cliffs of peat.

In approximate latitude 58° 28′, the canoes entered a heavy rapid three miles in length, in which the river has a fall of about forty feet. Hills of boulders from a hundred to a hundred and fifty feet high rise on each side, and the bed of the stream is formed of boulders that have fallen from both sides. The upper part of the rapid is deep and narrow, while the lower stretches are wide and shallow. Just at the foot of this rapid, as the river expands to quiet water, on the west side, a scarped bank twenty-five feet high shows, at the bottom, fifteen feet of Hills of boulders.

Red and white sandstone.

horizontally stratified, rather fine-grained sandstone, both white and bright red in colour. The red sandstone does not form regular beds, but runs down irregularly into the white. It is, however, usually thin-bedded and shaly, while the white is often moderately thick-bedded. The weathered surface of the red beds is blotched with rounded lighter spots. No fossils of any kind could be found in these sandstones. It is doubtless of Keewenawan age, the same as the coarse sandstone seen higher up the river.

For three miles below the heavy rapid, the river is wide, with low banks. Our camp was pitched on the east bank in a grove of small pines by this quiet portion of the stream. For a mile and a half below camp the river flows with an even current, and then a series of rapids begins and extends for four miles, to the mouth of Bad-water River.

Bad-water River.

Bad-water River is a hundred feet wide at its mouth, shallow, with a muddy bottom. Its water is clear and it is said to flow from a lake about eight miles long, lying to the east, in the midst of an extensive swamp. From the mouth of Bad-water River, Cree River continues to flow northward for three miles, through low undulating sandy country, and then it turns sharply westward to the mouth of Trout River, descending the last rapid in its impetuous course. A short distance above the bend, a number of cut-banks, on the sides of wooded hills, show sections of sand and gravel, consisting of rounded waterworn pebbles and cobbles of sandstone. The banks are wooded with Banksian pine or willow scrub to the edge of the water.

Trout River.

Trout River is a stream of light brown water about two-fifths the size of Cree River, though it is sluggish at its mouth, so that it is difficult to estimate its exact size. The Indians travelling southward formerly used to ascend it and portage across from its head into Cree Lake, rather than ascend Cree River.

Surrounding country.

Six hundred yards to the west a lightly wooded hill rises, close to the river, to a height of 120 feet. It is composed almost entirely of sand, though a few boulders are scattered over its summit. From its crest a very extensive view can be had of the surrounding country. To the west, a great level sandy or boggy plain, thickly wooded with pine, stretches away towards some low distant hills. To the north a similar country extends to the hills south of Black Lake. A small lake lies a couple of miles to the south-west, beyond which are some low hills. To the east, the view is not so extensive, and the country not so level.

From the mouth of Trout River, which was found to be in latitude 58° 37′ 40″, Cree River flows N. 30° E. for sixteen miles, measured in

a straight line, to the mouth of Sandy River. It has a moderate current, a general width of from 150 to 200 yards, and a sandy bottom. In one place, a cliff thirty feet high of unstratified till with boulders, forms the east bank, but otherwise the banks are low. Elongated, narrow sandy hills or ispatinows, similar to those on Cree Lake, make their appearance at the mouth of Trout River, and become very numerous as the river is descended. One clothed with Banksian pines, opposite the mouth of Sandy River, rises to a height of a hundred and eighty feet. It slopes lightly towards both ends, and is very steep on both sides, standing up like a knife-edge trending S. 65° W. It is composed almost entirely of sand, but a few boulders are scattered over its top and sides. From it many other similar hills may be seen, one, probably 300 feet high, lying in a direction N. 85° E. Ispatinows.

From the mouth of Sandy River, Cree River turns sharply westward, around the north end of the hill just described, and after a course of five miles, past several other high sandy ispatinows, empties into the south-west side of Wapata Lake, in the midst of a wide willow-covered marsh. We here crossed the lake for three quarters of a mile to the east end of Wapūs Island, where camp was pitched on the evening of July 21st, and where an observation of the sun determined the variations of the compass as 29° E. Wapata Lake.

The mouth of Cree River had now been reached, four days having been occupied in its descent. Its length is 108 miles, and its total fall is between 500 and 600 feet. Its upper part, to north latitude 58° 8′ is a roaring, foaming torrent, rushing along in many places at the rate of from ten to twelve miles an hour. The lower part is not quite so bad, though much of it is very swift and shallow. The current gradually slackens to the lake. General character of Cree River.

Wapūs Island is a low narrow ridge nearly two miles in length, lying S. 60° W. It is thickly wooded with spruce, birch, white poplar and a little larch. The north-west shore of the lake is also low and thinly strewn with boulders. Wapūs Island.

Two miles north-west from Wapūs Island is a strait in which is a rapid with a fall of a foot. Many fragments of mottled and thin-bedded, often shaly, sandstone are lying in the water, and the bottom of the strait seems to be composed of this rock, which is undoubtedly of the same age as that previously seen on the river. Below the strait, Wapata Lake again opens out to a body of water about six miles long and a mile and a-half wide. A high hill on an island and another on the north shore are apparently similar to those on the lower part of the Strait in Wapata Lake.

river. The shore is generally sandy or strewn with small boulders. Pine River empties into the south end of this lake. It is said to be a large rapid stream, which cannot be ascended far in canoes on account of rapids and fallen timber.

The river, flowing from the west side of the lake, is at first wide, with a scarcely appreciable current. A mile and a-half down stream a hill rises on the north bank to a height of 110 feet. It is composed of sand and some boulders. A cliff, standing forty-five feet above the lake, shows a section of sand, cobbles and boulders, all fairly well rounded. On the sides of the hill, at heights of seventy, eighty and ninety-five feet above the lake, respectively, are three well marked beach-ridges of rounded gravel, and the summit is composed of rounded cobbles, all showing distinct shore-lines of Hyper-Black Lake, which must have covered a large area of the surrounding country.

Old beaches.

At the point of this hill the river turns sharply northward, and flows for a mile as a rapid deep stream a hundred and fifty feet wide, between low cliffs of light pink sandstone. It then expands, and in a mile and a-quarter opens into the south end of Black Lake. At this point the west shore is low, and gently sloping to a beach of boulders, while hills rise on the east shore. The country is thickly wooded with small spruce.

Black Lake.

Area.

Black Lake is a long narrow body of clear water lying in a general north-east and south-west direction, with a greatest length of forty-one miles, a greatest width of nine miles, a shore-line of about 110 miles, and a total area, including islands, of two hundred square miles. On July 6th, 1893, its water had a temperature of 58° F. Its present name seems to have been given to it by David Thompson, perhaps from the dark hills of norite which overlook its north-west shore. By the Chippewyan Indians of Fond du Lac it is called Dess-da-tara-tua, or Mouths of Three Rivers Lake, alluding to the mouths of Cree, Stone and Chipman rivers which empty into it.

Name.

From the funnel-shaped mouth of Cree River, our course lay for two miles and a-quarter in a north-northeasterly direction across the most southern bay of the lake to a narrows with low bouldery shores, and thence onward in nearly the same direction for two miles and a-half, past a low sandy shore to the east end of a narrow channel running between a large island and the main shore. This channel is a hundred and fifty yards wide, with steep sand escarpments from eighty to a hun-

Deep narrow channel.

dred feet high on both sides, and runs quite straight in a direction S. 80° W. The water in it is deep and without current. It was followed for three-quarters of a mile, beyond which it appeared to continue on across the island, but the time at our disposal did not permit us to examine it further. On the sand-hills some white spruce grows, being the first seen north of the Churchill River. This sand ridge may, for a short time, have formed the north shore of that part of the lake to the south, and have held its waters higher than their present level, in which case this valley would mark the channel of the ancient river which has rapidly cut through the easily eroded sandy ridge.

For six miles north of this deep narrow channel the shores are very irregular, usually low, and more or less thickly wooded with small black spruce and pine. High sand-dunes form conspicuous hills at some of the points on the east shore. At the end of the above distance the lake expands to a width of nearly three miles, and its outline becomes much more regular. Its south-east shore is sandy, with high rounded hills of sand or boulders towards its north end. Its north-west shore runs for several miles along the foot of a sandstone escarpment 230 feet in height, which extends away towards the south-west, beyond the end of the lake, and north-east to within a short distance of Stone River. Where the west shore leaves the foot of the escarpment, it is bounded by sand-plains or terraces of greater or less height. The escarpment is composed of horizontally bedded white or light-pink, rather coarse quartzose, ripple-marked sandstone, often changing to a fine conglomerate. Other finer beds may occur in the upper seventy feet, but the sandstone throughout the lower 160 feet is all exposed on the face of the cliff. The smooth rock on the summit of the cliff is distinctly striated in a direction S. 70° W. At a height of 125 feet, an ancient, but post-glacial, shore-line is distinctly marked by a cliff twenty feet high, the foot of which is carved into caves, pillars and other fantastic shapes by the action of the water. It would appear probable that this beach was formed at the same water-level as the gravel bar on the summit of the hill between Wapata and Black lakes.

High sand-dunes.

Sandstone escarpment.

Athabasca sandstone.

Old shore line.

After following the foot of the rocky escarpment for several miles, the shore swings more to the east. It is at first strewn with boulders, and then for two miles is bounded by a cliff of sand rising to a sandy terrace. North-east of this again, is a low shore strewn with boulders, to a prominent point on which is an exposure ten feet in height of thick-bedded, coarse white sandstone or fine conglomerate. North of this point Stone River flows out of the lake along the line of contact of the Archæan and the Palæozoic rocks. Half a mile N. 30° E. from

Contact of Archæan and Palæozoic rocks.

the last point, and on the opposite side of the river, is a rounded boss, fifty feet high, of reddish-gray, well foliated, slightly biotitic granite-gneiss, striking N. 35° E. and dipping N. 55° W. at an angle of 75°. Its surface is rounded and covered with black lichen. In thin sections this rock is seen to be composed of quartz, considerably crushed; plagioclase, altered to some extent into sericite; orthoclase (?); and biotite slightly altered to chlorite.

From here Black Lake opens out into its largest expansion, the south-east shore turning sharply to the east, and the north-west shore continuing in a north-easterly direction. No sandstone is seen on the latter shore, it being composed of a high ridge of Laurentian gneiss.

The south shore was followed by Mr. Dowling, who gives the following description of it:—

South shore

"From the narrows, to which the long portage from Middle Lake leads, the shore eastwards is comparatively straight, broken only by a few salient points. Stratified sands, deposited in an ancient lake-basin, are exposed in a bay near the mouth of Stone River, showing in all a thickness of forty feet. A prominent feature on the shore to the south is the presence of a series of oval hills about 150 feet high, all lying in a broken chain, parallel to the shore or about east-and-west.

"The shores are mostly boulder-strewn, with sand behind, and the underlying rock is exposed in only one place, just west of the upper Stone River. There sandstone slabs are piled up on the point, and about two feet of sandstone in place is exposed at the water's edge. The beds are uneven and ill-defined, but are about a foot thick, of coarse grain and stained with red.

"The Stone River discharges into Black Lake by two mouths, inclosing an island of dark gneiss. Thus the boundary between the Archæan and the Keewenawan sandstone here is at the western mouth of this river."

North-west shore.

From Stone River, the north-west shore of the lake has a general trend N. 40° E., for fifteen miles, keeping close to the foot of a ridge from 200 to 400 feet in height, of a dark amphibolite, sometimes almost massive, and sometimes varying to highly hornblendic gneiss or hornblende-schist, striking with the trend of the ridge and dipping at a high angle away from the lake. Old shore-lines were not so distinctly marked here as on the face of the sandstone escarpment further south, but thirteen miles from Stone River, one ancient beach was

seen fifty-five feet above the present water-level, marked by a horizontal line of rounded pebbles.

Fir Island lies off this shore. It is a large rudely triangular island with an area of about twelve square miles, doubtless underlain throughout by horizontal sandstone. At its south-west point, cliffs of this white horizontally bedded sandstone rise to a height of fifteen feet above the water, and along its north-west shore are cliffs of sand forty feet high. Its northern extremity is a long point of boulders. Its other sides are low, but were not closely examined. The surface of the sandstone at its south end is strongly glaciated on a bearing N. 75° W. Fir Island.

About fifteen miles from Stone River, Chipman River, a rapid torrent fifty feet wide, tumbles over masses and points of gneiss and schist to join the lake. From the mouth of Chipman River, the shore leaves the foot of the high rocky ridge and swings more to the east, though it is still composed of very similar Archæan gneiss and hornblende-schist. Two miles along the shore, in observed north latitude 59° 17′ 34″, one of our Indian canoemen pointed out a place among the overhanging willows, where he stated that a portage left the lake on the canoe-route by which the Chippewyan Indians annually travel to their hunting grounds at the head of the Telzoa River; adding that the Telzoa River flows an unknown distance towards the north, into the country of the Eskimos and the musk oxen. On the information here gained the expedition of the following year was largely planned, when, without guides, the Telzoa River was descended for 800 miles to its mouth at the head of Chesterfield Inlet. Portage route to Telzoa River.

Just back from the shore and parallel to it, is a ridge seventy feet high, composed almost entirely of boulders, some of which are very large. These consist chiefly of a fine and even-grained red granite-gneiss,—none being seen like the dark hornblende-rock in the ridge to the west. Ridge of boulders.

The shore to the eastward is composed of granite, at first massive, and then with distinct gneissic foliation, and the bay north-east from the entrance to the portage seems to run along the line of contact between this rock and the hornblende-schist to the west. A point on the west side of the bay is composed of a very coarse, massive white muscovite-granite. Behind this point is a hill sixty-five feet high, of irregular masses of similar rock. Granite and gneiss.

A mile and a-half to the south, past some low granite islands, is a long low point of even-grained red granite. The general surface is

Glacial grooves.

well smoothed and marked by glacial grooves trending S. 72° W., while some lee surfaces show distinct grooves trending S. 52° W., probably made by the same glacier at an earlier date than the others.

Three-quarters of a mile east of this point, is another low point composed of similar granite, with a strike N. 75° E., and a dip N. 15° W. < 25°. For the next mile and a-quarter we travelled by a low shore strewn with boulders, to a small low island of very irregularly foliated gray gneiss, cut by veins of red pegmatite. Its surface is well smoothed, and marked by glacial grooves trending S. 60° W.

Islands of red gneiss.

For the next six miles numerous rounded islands, thinly wooded with black spruce and birch, lie off the moderately straight shore, which rises in places to a height of a hundred feet. The rock is all a reddish gneiss, mixed with similar granite, or cut by granite veins. It is occasionally jointed, breaking down into little cliffs, but the islands generally descend more or less gently on all sides to the water. Glacial striæ all run between S. 60° W. and S. 75° W.

From this point, where we left the north shore, the lake continues eastward for a couple of miles, to the foot of a high ridge of rocky hills. We turned southward, passing the point of an island of foliated

East shore.

hornblende-granite, to the east shore in north latitude 59° 13′ 28″ at a sand beach in front of high rocky hills of very similar gneiss, striking east and dipping south at an angle of 40°. A mile and a-quarter further south is the mouth of Stone River, which is here 300 feet wide. On each side rise little rounded hills of sand, wooded with spruce, pine and birch.

Athabasca Lake.

This lake lies in a general east-northeasterly and west-southwesterly direction, along the line of contact of the comparatively undisturbed and unaltered Palæozoic sandstones to the south, and the much disturbed and highly altered Archæan gneiss, schist, &c., to the north.

Area.

It has a greatest length of 195 miles, a greatest width of 35 miles, a shore-line of 425 miles, and a total area of 2850 square miles. According to Mr. McConnell* it has an elevation of 690 feet above the sea. Its depth has not yet been determined.

Tributaries.

Its principal tributaries are the Athabasca River from the south, and the Stone River from the east, while several other smaller streams,

*Report on a Portion of the District of Athabasca, by R. G. McConnell, Ottawa, 1893. Annual Report, Geol. Surv., Can., vol. V. (N.S.), 1890-91, p. 27 D.

mentioned or described later on, drain into it from the surrounding country.

Surveys.

The south shore of the lake, with the lower courses of some of the tributary streams, was examined and surveyed by Mr. Dowling in the summer of 1892; the north shore, east of Fond du Lac, was examined and surveyed by the writer in the same year; the remaining portion of the north shore was examined by the writer, and surveyed by his assistant, James W. Tyrrell, C.E., D.L.S., in the summer of 1893, and the results then obtained are included here in order to represent and state in more concise form the information at present available with reference to the geology of the lake.

Fort Chippewyan.

On the north shore of the lake, near its west end, the fur trading post of Fort Chippewyan has stood since the early part of the present century. To the west of it, facing the lake, a row of small houses has grown up, occupied by natives who are more or less dependent on the fur-traders for support, and at the end of this row is an Episcopal church and mission house. About a mile to the west, across a small bay, the Roman Catholics have a church and large mission establishment, around which is a small but well tilled farm, on low gently sloping land a few feet above the level of the lake. The surrounding country consists of evenly rounded rocky hills thinly wooded with small black spruce. The rock is generally a red and dark regularly banded hornblendic gneiss, and its surface is strongly marked by glacial striæ running N. 75° W.

North shore.

From Chippewyan, the north shore of the lake runs north-eastward for twelve miles to Poplar Point, along the foot of a rather high ridge of hills, composed of similar banded gneiss striking parallel to the general direction of the shore, and more or less nearly vertical. At Poplar Point, the gneiss contains many green epidotic bands. In front of the cliffs of gneiss are exposures of sand, containing pebbles and rounded boulders, most of which are of sandstone or conglomerate.

Fishing Point.

At Fishing Point, two miles further along the shore, the rock is a light and dark-gray gneiss, very irregularly foliated, and cut by many veins of opaque white quartz, with some veins or narrow dykes of dark-green chloritic and epidotic schist, which would seem to be a crushed and highly altered eruptive.

For the next mile, the shore is very rocky, and at the long point is composed of a light-green chloritic gneiss, consisting of quartz, plagioclase, chlorite, biotite and epidote. The quartz, which is present in large

amount, is very much crushed and broken. The felspar is present, often in large grains, which project on the weathered surface. This gneiss forms the shore some distance northward, and then recedes from the lake, after which the beach is sandy. A deep rounded bay is next
Cliffs of sand. passed, in the bottom of which are some rather high cliffs of sand, while towards the north it is terminated by a long, low sandy spit.

Some large islands lying off this portion of the shore are low and thickly wooded. They are probably underlain by Athabasca sandstone.

Huronian? sandstone. Camp was pitched on the 21st of June on the north side of the sandy spit, near its base. Close to this place is a low boss of highly altered calcareous sandstone, possibly of Huronian age. It is banded in reddish and greenish bands, strikes west, and dips north at an angle of 30° In thin sections it is seen to be composed of quartz, orthoclase, plagioclase, calcite, muscovite, (?) chlorite, pyrite and magnetite. In places it is cut by thin irregular veins of quartz, and often shows an imperfect slaty cleavage. Its surface is strongly marked by glacial grooves, trending S. 65° W.

Half a mile further north-east, is a rock of very similar composition, but finer grained and highly schistose, the strike of the schist being along the shore, and the dip almost vertical. Behind the rocky beach
Sandy terrace. a sandy terrace rises to the height of twenty-five feet above the lake, and half a mile back is a ridge of granite hills from 150 to 200 feet in height. For the next seven miles, the shore is formed of vertical or overhanging cliffs of schist, rising in places to a height of forty feet, but a stiff onshore wind, with a dense fog, prevented a closer examination.

In observed latitude 59° 6′ 32″, a little sandy beach offered a safe landing place, and we went ashore near the mouth of a brook four feet wide, around the mouth of which a good deal of ice was still clinging. The beach is in front of a low terrace, and close to it is a boss of light
Reddish-gray gneiss. reddish-gray gneiss, striking N. 15° E., for the schist has now given out. The surface of the gneiss is beautifully smoothed and striated in a direction N. 75° W. The variation of the compass was here found to be 31° 30′ E.

From here the shore turns more to the eastward and becomes lower and more irregular. It consists of points of reddish-gray biotite-granite or gneiss, without any persistent strike, between which are sandy bays, where the sand is often piled into high dunes.

Fishing Creek. Camp was pitched at night on the bank of Fishing Creek, on a pleasant flat covered with short grass and wooded with small Banksian

pines. A heavy storm detained us in this camp throughout the following day. Fishing Creek is 200 feet wide, but without current, and a mile from the lake it contracts to a small brook ten feet wide, flowing from a swamp. The hills behind are composed of reddish-gray biotite-granite, similar to that on the shore. From the mouth of Fishing Creek the shore was followed for sixteen miles, past Cypress Point to Gray-willow Point. The granite hills recede from the lake, forming a high ridge some distance inland, and the shore is low and sandy, with a sandy plain, fifteen or twenty feet above the water, stretching back towards the hills. A mile and three-quarters beyond Gray-willow Point, Scorched-dog Island lies a short distance off the shore, and is composed of sand and boulders, most of the latter being of red Athabasca sandstone and conglomerate. Gray-willow Point.

From Scorched-dog Island we travelled in a direction N. 65° E., for nearly seven miles across the mouth of a shallow bay to Maurice Point. The shore of the bay is sandy, except at one point, where there seemed to be a low boss of rock. The ridge of granite hills continues to recede until it is out of sight, and a sandy plain stretches back from the lake. On this plain rise some rounded wooded hills, but their character was not determined. Sandy shore.

Maurice Point is piled to a height of twenty feet with irregular angular blocks of reddish Athabasca sandstone, some ten feet in diameter, that have doubtless been derived from rock in place near at hand. This irregular mass of sandstone blocks extends back to a distance of 200 yards from the lake, and from it a gravel bar stretches westward into the woods, with a height of fifteen feet above the water, formed when the lake stood at a somewhat higher level than at present. Maurice Point.

From Maurice Point, we travelled N. 30° E., across the mouth of a deep bay, for seven miles to Spring Point, just north of which camp was pitched on the evening of June 24th. Behind camp, within the woods of small Banksian pine, are two well rounded old gravel beaches, respectively twenty and thirty-five feet above the present water-level, indicating higher stages of the lake. The point is composed largely of slabs of reddish Athabasca sandstone and conglomerate, which, on the south side, cover all the upper portion of the slope. All are angular and must have been broken from rock close at hand and piled up by the ice. Scattered along the shore, with the masses of sandstone, are a large number of rounded boulders of gneiss, green schist, massive green amphibolite, and red or green Huronian conglomerate, with moderately well rounded pebbles of granite and gneiss up to eight inches in diameter. Spring Point.

The next day was stormy, but with considerable difficulty a distance of eleven miles was made. Several low wooded islands were passed, and the beach was for the most part low and sandy. At camp the shore was composed of a hard, evenly foliated schist, varying from green to reddish-brown in colour, and probably of Huronian age. In this section it is seen to be a confused mass of decomposition products such as serpentine, chlorite, etc.

Chlorite schist.

At a point a mile and a-quarter down the shore, similar schist outcrops, much reddened with iron. It is cut by many irregular veins of quartz, holding hæmatite. Its surface is smoothed and striated, S. 50° W.

At the next point, two miles distant, similar dark green schist is exposed striking north, and dipping west at an angle of 70°. It lies against a boss of red highly felspathic granite, and is very much contorted.

From here onward to the mouth of Cypress River, the shore seems to be composed of similar schist. Beyond Cypress River is a ridge of rounded wooded hills between 300 and 400 feet in height, possibly of gneiss, but we were not able to visit them, and their exact nature is uncertain.

South 75° east, two miles and a-half, across the mouth of the bay into which the Cypress River flows, Half-way Point consists of a hard and compact, fine-grained, thinly foliated green Huronian schist, interlaminated with bands of fine-grained crushed granite or gneiss, all with a very irregular strike, but generally dipping more or less towards the shore.

Half-way Point.

In this section the schist is seen to be a clastic rock composed of more or less rounded grains of orthoclase, plagioclase, quartz, and a fine-grained sericitic groundmass. The fine foliation is due to the parallel disposition of numerous minute scales of light-coloured biotite, undergoing alteration to sericite. With these are associated small particles of spheen, and small black dust-like inclusions, probably of iron oxide. That the rock has been submitted to great pressure is shown by the uneven extinction of the larger crystals and the alteration of the groundmass.

Clastic schist.

The granite is composed of quartz, orthoclase largely replaced by microcline, plagioclase, augite, muscovite, biotite largely altered to chlorite, titanite, epidote and calcite. Generally speaking the granite is very poor in ferro-magnesian constituents, and the quartz and felspar have been granulated by pressure.

Granite.

At the southern point of Slate Island, two miles eastward of Halfway Point, fifty feet of thickly foliated dark-brown Huronian schists outcrop, striking westward, and dipping southward at an angle of 60°. To the north of these schists is a band of coarse green Huronian conglomerate, with well rounded pebbles and a matrix of green chloritic material. Slate Island.

The variation of the compass was here determined to be 27° 10′ E.

At the south-east point of the same island, is a cliff of thinly foliated red schist, very similar to the last, but not so finely jointed. It is very evenly banded, and not much contorted, with a strike north, and vertical dip.

Five miles south-eastward from Slate Island, 59° 34′ 18″ was the latitude obtained from a meridian observation of the sun, on the east point of a small island lying off the south-west side of a large low wooded island. Near by was a low exposure showing three feet of typical gray or reddish coarse-grained horizontal Athabasca sandstone, occasionally containing a few rounded quartzite pebbles. The large island also seems to be composed of the same sandstone. Athabasca sandstone.

North-east of this island Charlôt River flows into the north side of the lake. Up this river the Chippewyan Indians have a canoe-route to a series of lakes, from which they descend another stream to the south side of Great Slave Lake. While crossing Athabasca Lake some Indians were met who had just descended Charlôt River from Charlôt Lake, near the watershed, where they had been hunting during the winter. Charlôt River.

From Charlôt River the shore for several miles southward is very rocky, high hills sloping steeply to the water. One point, in latitude 59° 32′, consists of a red and green gneiss, rather thinly foliated, striking N. 60° E. and dipping S. 30° E., at an angle of 30°. It is cut by many irregular veins of white, opaque quartz. In thin section the rock is seen to have been crushed and recrystallized, having been subject to great pressure. The quartz and orthoclase are arranged in elongated much broken augen masses, though a few of the felspar crystals have survived the crushing. The original bisilicates have disappeared, and are replaced by hornblende, which is now largely altered to biotite and chlorite. It also contains some muscovite, a few large zircons, and a good deal of secondary iron ore. Red and green gneiss.

The next point, four miles further south, is also composed of similar gneiss, here striking east and dipping south at an angle of 65°.

The variation of the compass was here found to be 32° 30′ east.

Cracking-stone Point.

We next crossed a deep bay, in a direction S. 31° E., for seven miles and a-half to Cracking-stone Point, east of which a steep rocky wall extends along the south side of the bay. This point is composed of massive, light-red and green coarse altered hornblende-granite, which rises in rounded glaciated knobs, on the summits of which are strong glacial striæ trending S. 75° W.

From Cracking-stone Point, we turned sharply eastward, and kept in narrow channels between islands of granite similar to the last. At about three miles distant, camp was pitched on the evening of June 26th, in a little sandy cove overshadowed by aspens. The rock on the adjoining hills is a well foliated reddish-gray hornblende-gneiss, the heavy bands striking N. 70° E., and dipping S. 20° E. at an angle of 35°.

Huronian quartzite.

For the next four miles, we wound among islands wooded with spruce, poplar and birch, in a direction a little south of east, to a point composed of a hard white recrystallized Huronian quartzite, which in thin section shows clear evidence of pressure and crushing. No stratification could be seen in the rock at this point. It is overlain, probably unconformably, by a nearly horizontal, coarse, red conglomerate composed of rounded pebbles of white quartzite in a coarse sandy matrix. It was impossible to make a thorough examination of this rock, but though it is much more highly altered than most of the Athabasca sandstone and conglomerate around the lake, it is probably of the same age.

For a considerable distance eastward from this point the shore is composed of the white Huronian quartzite.

Dip and strike.

At a point two miles and a quarter east, in latitude 59° 21′ 50″, the quartzite is reddish in colour, highly altered and very compact, but it is clearly seen to strike N. 40° E. and to dip S. 50° E. at an angle of 50°. The quartzite continues to form the moderately straight shore to a point six miles and a-half distant, where it is beautifully white and so much jointed and fissured that it is impossible to be sure of the true stratification, though it appears to strike N. 20 E. and to dip S. 70° E. at an angle of 70°.

Beaver-lodge Island.

A mile and a-half out in the lake, Beaver-lodge Island rises as a high rounded dome of white quartzite. The west side of the island is beautifully terraced, the plains of quartzite gravel extending step above step to the summit.

On the north shore of the lake, the Beaver Hills rise to a height of from 500 to 600 feet.

Four miles and a-half further east, we landed on a small island of quartzite, greatly crushed and recrystallized, and containing, besides grains of quartz, a small amount of chlorite and sericite. It is interlaminated with thin bands of light-green coarsely crystalline pyroxene rock. The rock has thus a well foliated appearance, the strike being N. 25° W., and the dip S. 65° W., at an angle of 10°.

Hill of quartzite and iron ore.

At a distance of a mile and a-half from this island, in a direction N. 66° E., a conspicuous red hill rises 125 feet above the water, its abrupt red cliff standing out boldly towards the south-west. On its north-eastern side, at its base, it is composed of thinly fissile quartzose schist, very much reddened, striking N. 30° W., and dipping S. 60° W., at an angle of 10°. Farther up the side of the hill the rock is a quartzite, interbedded with layers of hæmatite, which in some places forms the larger part of the mass. The summit of the hill, several hundred yards in length, is composed of a highly hæmatitic quartzite, mingled with a large quantity of limonite, especially on the higher points. In places the rock is a conglomerate, with quartz pebbles, and a matrix of limonite. Other similar red hills can be seen in the distance on the strike of the rocks, and the total amount of iron here and in the vicinity is doubtless very large.

Biotite-schist, probably a crushed gabbro.

Camp was pitched two miles and a-half farther east, on a little clay flat on the bank of a small brook, among a few poplars and willows. Near at hand is a boss of thinly foliated dark-gray biotite-schist striking N. 40° E. and dipping S. 50° E., at an angle of 50°. In thin sections this is seen to be a very much squeezed rock, with the quartz grains all granulated, a large amount of secondary biotite, and cores of serpentine, which probably represent porphyritic crystals of augite. It is, therefore, probably a crushed gabbro. Just to the north is a hill of reddish fine-grained gneiss, with the same strike and dip.

For the next seven miles, to Old Man Point, the journey was continued in a dense fog through narrow channels between small islands. A stop was made at one island about half way, which was found to be a rounded boss of red granite. The surface is well smoothed and strongly marked with glacial grooves trending S. 45° W.

Old Man Point.

Old Man Point is composed of a dark, regularly foliated hornblende-schist, striking N. 15° E., and, at the old house, with vertical dip; but on the west side of the point the dip is S. 75° E., at an angle of 30°. East of Old Man Point the islands are composed of reddish-gray

heavily laminated gneiss, but a point, four and a-half miles distant, was found to consist of a laminated gabbro striking N. 45° E. and dipping S. 45° E., at an angle of 70°. The gabbro consists essentially of plagioclase, augite and biotite, the augite being much altered to serpentine and chlorite. Pyrite, apatite and zircon are present as accessory constituents. It is cut by several veins of white quartz, carrying a considerable quantity of hæmatite and pyrite.

Gabbro.

For the next ten miles the shore is very rocky, with a few sand or gravel beaches. At a point three miles east of the mouth of Beaver River, the rock is a fine and even-grained holocrystalline, reddish foliated gabbro striking N. 25° W. with vertical dip. The gabbro consists of bytownite, diallage and a considerable amount of brown biotite. The diallage shows incipient alteration to hornblende and is stained with hydrated oxide of iron, which is chiefly deposited along the planes of parting. The surface is marked by strong glacial grooves, trending S. 60° W.

Garnetiferous gneiss.

Eight miles farther, camp was pitched on a rocky island behind a beach of coarse gravel. The rock is a coarse garnetiferous gneiss, striking east, and with almost vertical dip. The timber in the vicinity is chiefly Banksian pine, but there is also some small white and black spruce, small balsam poplar, and aspen up to six inches in diameter. The next morning we travelled eleven and a half miles through heavy seas to the now deserted trading post known as Fond du Lac.

This was the most westerly point reached on the lake in 1892, and the description of this point and of the remaining portion of the north shore of Lake Athabasca is drawn from the writer's survey and examination made in that year.

Fond du Lac.

The lake is here but two miles wide, and the trading post is situated on a low point of sand and rock on its north shore. It consists of a number of well-built log houses, with a yard surrounded by a pallisade of stout posts. In 1892 it was in charge of José Mercredi, a venerable old French half-breed seventy-five years of age, who had lived there continuously for the past forty-seven years. In the immediate vicinity is a Roman Catholic mission church, where a priest lives during the winter. Mr. Mercredi informed me that in the early part of the century the Hudson's Bay Company had a trading post on a point on the south side of the lake, lying in a direction S. 20° W., and that the three inhabitants were killed by Chippewyan Indians. At the same time the North-west Company had a post on a point on the north shore a short distance farther east, but after the murder of the Hudson's

History of the post.

Bay Company's men they moved across to the point on the south shore. The place was afterwards abandoned until 1845, when Mercredi arrived and built the present post. It is on one of the principal lines of travel of the Barren Ground cariboo, in their regular migrations north and south.

The variation of the compass was here found to be 31° E., and the mean of two observations taken in the yard of the post determined the latitude at 59° 18′ 59″.

The rock is a gray quartzose garnetiferous gneiss with rather irregular strike, but generally about S. 70° E., and a dip about S. 20° W. at an angle of 45°. It is cut by a number of veins of red pegmatite. The surface is well scored by glacial striæ, trending S. 51° W.

Joined by Mr. Dowling.

Here on the 28th of July, 1892, the writer was joined by Mr. D. B. Dowling, bringing provisions for the remainder of the journey. He had descended the Athabasca River, and had surveyed the south shore of the lake to this place. His report will be found on a later page. The collections made up to this time were sent to Fort Chippewyan, to be forwarded up the Athabasca River and thence to Ottawa.

On July 30th we again started eastward, Mr. Dowling taking the south shore as before, while the writer made a survey with compass and boat-log of the north shore.

Grease Mountain River.

From Fond du Lac eastward to the mouth of Grease Mountain River, a distance of nine miles and a-quarter, the shore, and the many low islands lying off it, are composed of gneiss of very uniform character, varying in strike from N. 45° to N. 70° E. Off the mouth of the river is an island of compact green gneiss, showing strong glacial groovings, trending S. 75° W. The point off the mouth of Grease River is composed of dark-green well foliated schist, striking N. 30° E. and dipping S. 60° E. at an angle of 80°.

Canoe route to the north.

A Chippewyan Indian was here met and entertained to dinner, and from him we learned that his people had a canoe-route up this river to Rabbit Mountain Lake, on the edge of the Barren Grounds, and from this lake a large river flows northward into unknown country.

Garnetiferous biotite-gneiss.

A short distance east of Grease River Point, is a rounded rocky point, composed on its outer side of a dark-green garnetiferous biotite-gneiss containing a large quantity of plagioclase felspar, while on its inner side it consists of a red, much sheared gneiss, containing but

a small amount of biotite. The two are separated by a fairly sharp vertical line of contact, striking N. 65° E. parallel to the foliation of the gneiss on each side.

Half a mile further east, on a small island off a point, the rock is a dark-green thinly foliated garnetiferous biotite-gneiss, containing many phenocrysts of red orthoclase. The biotite is largely altered to chlorite. It is irregularly and sinuously foliated, and cut by many winding veins of fine-grained compact red granite. The surface is smooth and strongly grooved in a direction S. 58° W.

Two sets of glacial striæ.

Five miles and a-quarter east of Grease River Point, the surface of a small island of similar green thinly foliated gneiss shows clearly two distinct sets of glacial striæ, an earlier one trending S. 65° W., parallel to the other striæ seen almost everywhere along the shore, and doubtless made by the ice sheet from the north-east, and a later one trending S. 35° W., probably made by a local glacier descending from the high land to the north, after the greater ice-sheet had withdrawn. Half a mile further east, a portion of the moraine of this later local glacier may be seen as a great stretch of huge broken masses of rock, forming a prominent point, and covering the shore for a considerable distance beyond it. Half a mile still further east, on the surface of porphyritic biotite-gneiss, the same two sets of striæ are even better shown, the older one, seen on lee surfaces, running S. 65° W. as before, while the later one, which is strongly marked over the surface generally, trends S. 20° W. across the lake towards a valley on its south shore. Athabasca Lake is here five miles wide, and lies in a long narrow valley with a steep sandstone escarpment between 400 and 500 feet high on its south side. The later glacier from the north flowed into the valley at this point, and probably reached across to the south side, completely filling it and damming up the water from the east to the height of the sandstone plain on the south, which is at about the level of the high beaches previously described on the banks of Cree River and along the west shore of Black Lake. The occurrence of an ice-dam across the valley accounts fully for the former existence of a large lake in the present basin of Black Lake. Without the ice-dam, or some other dam of which no evidence can be found, the water of Black Lake could not have stood much above its present level in glacial or post-glacial times, for the great valley of Athabasca Lake, which extends eastward to Black Lake, dates back to a period long before the glacial epoch.

Moraine.

Ice-dam.

The rock on which the glacial striæ are shown, is a dark fine-grained biotite-gneiss, with small porphyritic crystals of orthoclase, striking

S. 60° E. and dipping S. 30° W. at an angle of 37°. At another point, half a mile farther east, a similar porphyritic gneiss has a wavy strike N. 70° E., and a dip S. 20° E. at an angle of 55°.

Two miles farther south-east, across a deep bay, is a high rocky point of very similar gneiss, striking N. 60° E., and dipping S. 30° E. at an angle of 75°. At the point of the cliff it becomes very coarse and heavily jointed.

From this point, a deep bay was again crossed, in a direction S. 35° E., to a small low bare island of highly garnetiferous orthorhombic-pyroxene-gneiss or foliated norite, weathering with a rough pitted surface, striking N. 70° E. and dipping S. 20° E. at an angle of 50°. Interbedded with the gneiss are some quartzite bands holding a large quantity of pyrite. A mile and a-half to the south-east is a low sandy island, on which camp was pitched for the night, behind a beach of rounded boulders, in open woods of birch, spruce and Banksian pine. Observations on the sun taken here determined the latitude as 59° 15′ 35″, and the variation of the compass as 37° E. To the south, a steep unbroken escarpment of horizontal Athabasca sandstone rises to a height of between four and five hundred feet; while the north shore is irregular and broken, composed chiefly of foliated norite, which rises into hills several hundred feet in height. Some good white spruce, up to fourteen inches in diameter, is growing on the points.

Norite.

Athabasca sandstone.

For twenty-three miles, the lake continues eastward with a general width of one mile, though towards the end it expands to two miles. The north shore is indented with small bays and is chiefly composed of norite, often highly plagioclastic, folded in an easy anticline, the strike at the different places being shown on the accompanying map. In places it is garnetiferous, and it is generally well foliated, the foliation being distinctly brought out on the weathered surfaces. In longitude 106° 20′, there is a high hill behind the shore, composed of a dark greenish gray, compact, fine-grained, heavily jointed granite. In thin section it is seen to be composed of quartz, orthoclase and biotite, the latter being fairly evenly disseminated, and all oriented in one direction. The quartz shows wavy extinction. It is therefore a typical biotite-granite-gneiss. On adjoining parts of the shore this gneiss cuts, or is interlaminated with, the greenish norite.

Granite hill.

The rocks are almost everywhere glaciated, the glacial striæ generally trending westward, down the valley of the lake.

At the east end of the lake, is a gently rounded hill or ridge twenty-five feet high, consisting of sand and a great number of well-rounded boulders, chiefly of sandstone, though a few are of gneiss. The hill, which now forms the east end of the lake, appears to be morainic, and probably is a small recession moraine of the glacier that flowed westward down the valley.

Morainic hill.

South shore of Lake Athabasca.

The south side of the lake, from the mouth of Athabasca River to here, and the lower courses of the streams that flow into it, were examined and surveyed by Mr. Dowling, and his report is as follows:—

"The streams entering Athabasca River from the east are small, with the exception of the Clearwater, which drains a considerable portion of the country lying to the north-east of Fort McMurray. The hills that form the watershed between the streams flowing northward to Lake Athabasca, westward to Athabasca River or southward to Clearwater River, are irregularly scattered over the surface of the plateau, but are spoken of generally by the Indians as the Muskeg Mountains or Hills. The source of the Clearwater River is near that of Old Fort River, which empties into Athabasca Lake, near its west end or just east of Athabasca River. In the spring of the year the Indians, with small canoes, have passed from one of these streams to the other, by a portage which takes them two days to cross. By a longer portage they can cross from the head-waters of Clearwater River to Fire-bag River, the largest stream entering Athabasca River between Fort McMurray and its mouth."

Muskeg Hills.

Fire-bag River.

General character.

"This stream, though not of any considerable size, has in the lower part of its course cut a deep valley through the modified drift and sands of the plateau, and in its bed are exposed rocks of Cretaceous and Devonian age. The surface of these rocks rise but slightly above the flood plain of the Athabasca River, so that low exposures only are seen, while the main exposures of the escarpments in the valley are of the overlying drift and stratified deposits extending southward from Lake Athabasca basin.

"For twelve miles above its mouth, the stream occupies a wide valley, winding from side to side, cutting into the banks, but exposing only sands and clays, apparently either redeposited river silts and sands or material slidden from the sides of the valley. Higher up the stream small exposures of Devonian limestone are found in its bed, causing rapids or small falls. The first one shows horizontal beds of hard

thin-bedded limestone containing traces of *stromatopora*, but no other signs of fossils. In this vicinity, the top bed only is of coralline limestone, resembling somewhat the lower part of the Devonian of Lake Winnipegosis, and below this are thin beds in a shattered condition. Sulphurous springs were noticed issuing from these. The top beds are yellowish to orange in colour and the lower are bright yellowish to ashy gray. Devonian limestone.

"At a distance of eighteen miles in a south-easterly direction from its mouth, the stream divides, the smaller branch coming from the north-east and apparently draining nearly all the country as far as the head-waters of Jackfish River, which enters the delta of the Athabasca. The main stream continues in the same south-easterly direction, coming from the hilly country near the source of Clearwater River.

"At the Forks, the sections in the banks of the valley are perhaps the most clearly defined of any in the district. The stream, impinging against the east bank, has cut it away and formed a steep escarpment in the clays and sands, exposing over 140 feet of the stratified deposits forming the plateau. The Devonian limestone, which has formed the floor of the valley for five or six miles, is here overlain by four feet of 'tar sand.' Further down the river this sand seems to have been carried away by glacial action, leaving occasionally small patches on the surface of the limestone. Tar sand.

"The section at the forks of the Fire-bag River, is in descending order, as follows :— Section of lacustrine deposits.

1. Stratified sand	90 feet.
2. Stratified clay	40 "
3. Tar sand (Dakota)	4 "

"(1) The bedding in this is accentuated by dark streaks of sand saturated with tar. In the upper part, nodules and small pieces of irregular shape are arranged on the lines of bedding, while the lower half is false-bedded, but the tar streaks appear as saturated portions of the beds and serve to strongly mark the nature of the bedding.

"(2) At the top a fine red clay, in streaks three inches deep, alternates with thin partings of gray clay. Gradually the red bands decrease in thickness and in three or four feet the whole mass is gray. The middle of the exposure is a hard clay slightly darker in colour and approaches shale in compactness. A few small pebbles were seen near the lower part and the clay smelt of petroleum, and probably rests on the 'tar sand.'

"At a short distance from this exposure, the limestone (Devonian) was again seen, showing the 'tar sand' (Dakota) resting on its surface, so that in the preceding section the limestone was probably at no great depth.

Glacial striæ. "The surface of the limestone was striated in a direction about west-south-west and in the lower part of the valley boulder-clay was seen at the base of the sections or beneath the stratified clays and sands.

"The surface of the country is covered with a small growth of Banksian pine, while in the valley spruce and occasional black poplar and birch were seen."

The South Shore of Lake Athabasca.

Big Point. "Just to the east of the delta of Athabasca River, a high ridge comes out to the lake on the point near the mouth of Old Fort River. The ridge is probably of morainic material, but is flanked by terraces of gravel and sand. Its trend is S. E. and N. W., and it forms a divide between the waters discharging by the Old Fort River and those of the Jackfish River, running on the west.

"The outlying islands are composed mainly of loose material. Goose Island is low, and is made up of sand and gravel with sandstone boulders on the shore. The islands in the bay east of Big Point are similarly composed of loose material.

Old Fort Point. "Old Fort Point is formed by an oval hill of sand and gravel similar to the islands, but connected with the main land by a low strip of ground flanked on both sides by marshy and swampy tracts, forming bays on either side. In the eastern bay, which is much the deeper, a small stream enters. This is found to come from the south, and is reported

Old Fort River. as being much longer than any of the streams entering the south side of the lake. It is known locally as the Old Fort River, and seems to have a larger flow of water than the Fire-bag or William rivers. In its lower part it cuts through the later deposits and reaches the Athabasca sandstone, which here appears in beds lying about horizontal. The higher land south of Old Fort Bay, lies about four miles from the mouth of the stream, and the sections made in it by the river show

Stratified sands and clays. seventy-five feet of stratified sand lying above ten feet of fine blue clay—a part of the similar section seen on the Fire-bag River, except that here, the red colour at the top of the clay is wanting, and no tar was noticed in the sand.

"At a distance of eight miles from the lake, solid rock is met for the first time, in the bed of the stream. It is in the form of a fine-grained

and very hard sandstone, similar in texture to the Potsdam sandstone of Eastern Canada. It is light coloured, weathering rusty, and in thick beds, lying about horizontal. The river has cut down to the surface of this rock, and for a considerable distance above this the stream falls over a number of steps, forming small cascades at each bed with a short strip of smooth water between. Athabasca sandstone.

"The hills, at the distance of eight miles and a-half from the lake, appear in ridges running W.S.W. and E.N.E., and where cut into by the river, show till and boulders with a colouring of red, doubtless due to a mixture of red sand and sandstone fragments, probably derived from the disintegration of a red sandstone in the vicinity. The stratified deposits seen in the lower part of the valley were laid down on the uneven surface of the till and the hills in some cases protrude above the stratified beds. Red boulder-clay.

"The sandstone is exposed again on the shore of Lake Athabasca at Stone Point, and loose blocks of large size are found on the next point five miles farther east. The shore between Old Fort Point and Stone Point, or Pointe de Roche, east of Old Fort Bay, is generally low and marshy, but a long spit or point extending to the south-west from Stone Point, incloses a part of the bay to the east of it. This spit is covered by sand-hills and on the lake side the waves have encroached so that there is a continuous low cliff of sand. Stone Point.

"The shore eastward to the narrows is very monotonous, generally a sand beach with sand cliffs just behind. William River, which empties about half way along the south shore, has formed a delta which is the most prominent feature on this side. The point thus formed is called Point William, and the mouth of the stream is found near its extreme north-western end. A small channel also comes out on the eastern side of the point." Character of shore east of Point William

William River.

"The Athabasca sandstone is met in this stream twelve miles above its mouth, and thence upwards for seventeen miles, which is as far as the river was explored. The river in this distance falls about forty-eight feet, in short cascades over the beds of sandstone. The delta is mostly a low flat sand-plain, covered with Banksian pine and occasional black spruce. The higher ground is found to commence on a line in continuation with the main shore, and consists of a great thickness of sand, forming a plateau extending to the south, past the limits of our exploration. The section in the river-valley shows horizontally Sandstone.

stratified sand up to about one hundred feet, but on the surface of the plateau, which is mostly bare, sand-hills rise in some cases nearly a hundred feet above the general level. Occasionally on the summits of these hills large boulders or angular fragments of a dark-gray gneiss are found.

Boulder ridges.

"A boulder ridge, which seems to be beneath and protruding through the sands, crosses the river about nineteen miles from its mouth. This ridge is made up of more rounded material, and seems to be a continuation of a high ridge or series of long hills which lie to the east, called the Fish Mountains. These hills are probably of the same character as the ispatinows around Cree and Black lakes. Above the ridge the surface is more even and covered with a small growth of Banksian pine.

Athabasca sandstone.

"At the first rapids the barrier is found to be a light coloured sandstone, in thick beds lying about horizontal. No trace of fossils could be found in any of the beds. Two and three-quarter miles above the first rapid about fifteen feet of sandstone beds are exposed. The lower beds are stained red and pinkish, while the upper ones are of coarser grain and lighter in colour, and six to eight feet thick. Above the boulder ridge, at a fall of five feet, the sandstone seems slightly disturbed and is dipping S. at an angle of 5° the beds show some local false-bedding, but the texture and general appearance is similar to the last. Glacial striæ run S. 75° W.

Fish Mountains.

"Between the mouth of William River and Beaver River the shore is very regular, broken in only one place by a prominent point. This is a small hill of gravel and sand which almost forms an island, but is connected to the mainland by two bars of sand inclosing a small pond. The country behind rises more abruptly. The Fish Mountains or Hills are seen as a wooded ridge 200 feet high about five miles inland, and are the edge of a higher plateau which gradually approaches the lake shore. At Beaver River this high country reaches to within a short distance of its mouth, and the lower part of the stream cuts a short gorge through it, in which are many falls and rapids. The Indians call this stream the Grand Rapids River, and it is probable the river here falls over a considerable series of sandstone steps, as the surface of the sandstone terrace seems to rise rapidly toward the east.

"A small section was seen on the lake, seventeen miles west of Beaver River, at the mouth of a small creek.

"The section is 12 ft. 10 in. in thickness, and is composed of:— Section of sandstone near Beaver River.

Light grayish-yellow to white sandstone, not very hard, in beds of 5 in. and 6 in., splitting thinner. Cleavage cracks have broken the beds into blocks 1 to 2 ft. square, so that the whole falls easily. A few green nodules are found scattered through the bed	7 ft.
Thin shaly sandstone, green and red mottled, split readily into thin plates	5 ft.
At the base a bed of light-coloured fine-grained sandstone is found to contain many small disc-like nodules of irregular shape, of a light green cherty material	10 in.

"From Poplar Point to its east end, the lake lies in a narrow channel, the south shore of which, for fifteen miles east of Fond du Lac, is low, mostly boulder-covered, with a high escarpment of sandstone behind. Occasionally small low exposures of sandstone are found. Poplar Point is underlain by sandstone and the shore is made up of a ridge of fragments of this rock. Coarse-grained sandstone beds are seen on a small island near the point. Poplar Point.

"The high escarpment rising to the south of the lake comes out on the shore east of Fond du Lac, and seems there to be nearly all of sandstone beds with possibly a cap of till. On the shore the sandstone is exposed in a series of steps, rising gradually back to a height of eighty feet. Near the top of the hill the beds are seen again and at this point (15 miles east of the post) the thickness exposed is 120 feet. The beds range from eight inches to two feet in thickness, and are of a hard pinkish sandstone with a few oval impressions which may be organic. This escarpment seems gradually to rise to the east as it approaches the east end of the lake, and with the high land to the north forms a narrow gorge in which the lake is confined to a narrow river-like stretch of water. Angles of elevation were taken on trees on the summit of the ridge in two places, giving heights of 431 feet and 300 feet. It would thus appear that the sandstone here attains a thickness of over 400 feet, and that the surface has a slight dip to the west so that at the mouth of the Athabasca River it has declined to about the lake level." Escarpment of sandstone. Thickness of Athabasca sandstone.

Stone River.

Stone River flows quietly into the east end of Lake Athabasca around the north side of the morainic ridge that forms the eastern boundary of the lake. It comes from the eastward in the bottom of the great valley between the highly altered Archæan rocks to the Great valley.

north, and the comparatively unaltered Athabasca sandstones to the south, a valley which, farther west, has been shown to be occupied by Athabasca Lake itself.

Hill of norite. Opposite the morainic ridge, the north bank of the river consists of a mass of boulders, behind which is a hill 270 feet high, of dark-gray foliated norite, the lamination of which comes out strongly in weathering, and is generally more or less horizontal. In thin section, this norite is seen to be composed largely of orthorhombic pyroxene. In places the surface is quite smooth, and shows strong glacial grooves trending N. 80° W. The sides of the hill are wooded with small birch and poplar, while its summit is bare of everything but a little black lichen.

Low banks. Proceeding eastward, the river is found to have an average width of from 200 to 300 yards; the banks are low and overhung with willows, and generally consist of alluvial clay, but a point on the south side, four miles above the mouth, is composed of similar foliated norite or pyroxene-gneiss, striking S. 80° E. and dipping N. 10° E. at an angle of 25°.

First portage. Above this point the current becomes gradually stronger, to the foot of a rapid with a descent of about eight feet. The canoes were landed at a sandy beach on the north bank just below the rapid, and from this beach a portage 660 yards in length was made through pine woods, over stiff clay and rock, to a bay behind a rounded boss of rock at the head of the rapids. The rock is a dark-gray fine-grained norite, weathering to a very light-gray colour, and in places slightly foliated S. 35° E. The summits of the knolls show distinct glacial grooves trending N. 60° W. Just west of the head of the portage, a rounded hill of similar gneiss rises boldly to a height of 150 feet out of the middle of the valley, its sides green with small poplar, birch, and pine through and over which the smooth rock, blackened with lichen, projects in rounded bosses. On both sides of the hill a wide bottom-land, wooded with pine and poplar, stretches away to sloping hills, the sky-line to the south being even, that to the north rugged and broken. The low banks of the river are overhung with willows.

Above the rapid the river opens into a wide lake-like expansion, into the north side of which Carp River empties. This stream is a hundred feet wide, and its water is white with suspended clay.

Above the mouth of Carp River, a prominent point projects into the north side of the lake. The rock composing the point is a dark fine-

grained massive much-jointed garnetiferous amphibolite, consisting of hornblende and plagioclase, with a large number of garnets and some titaniferous iron ore. As the hornblende would seem to have been altered from pyroxene, this rock is probably a modified form of the norite composing most of this shore. It is cut by wide bands of quartzitic granite running S. 60° E. The surface of the rock, at the end of the long point, and close to the water, is well polished and grooved in the direction N. 55° W., the smooth rounded surface facing the south-east, and the jagged broken one the north-west. Amphibolite.

Above this point the river gradually narrows, and the current increases, until it changes to a swift narrow stream with steep rocky walls. At a point on the north bank, three miles further up stream, a red foliated gneiss, striking N. 65° E., and with vertical dip, is in irregular contact with the dark-green massive amphibolite. A mile farther up, just where the river turns sharply to the south, the stream is narrow and flows between bosses of Archæan rock. The rock on the north side consists of narrow dyke-like bands of dark-gray amphibolite, striking straight along the river. These bands are almost vertical, and run through a reddish gneiss, which is well banded in the same direction. They also cut the gneiss irregularly, and send irregular arms into it. A hundred yards back, across a little swamp, is a rugged vertical cliff 150 feet high, of the same dark greenish-gray amphibolite. Steep rocky banks.

Three-quarters of a mile above the bend, having passed through rapid broken water, we came to the foot of a series of very heavy rapids, in which the water has a total fall of about 160 feet. The lowest rapid is a beautiful cascade where the water tumbles over a ledge of irregularly jointed amphibolite, and then rushes in two narrow gorges on both sides of a rugged rocky island. A small island a short distance below consists of green and red foliated gneisses striking S. 75° E. and dipping N. 15° E., at an angle of 75°. Heavy rapids.

A quarter of a mile below the foot of the rapid, on the south bank, the canoes were pushed in among the willows over a soft muddy, swampy flat to the beginning of Woodcock Portage, so called because we roused a woodcock (*Philohela minor*), in one of the swamps as we crossed it, this bird being exceedingly rare so far north. Woodcock Portage.

Opposite the end of the portage is a rocky knoll consisting of dark, rather coarse-grained amphibolite, generally foliated in an easterly direction, and spotted with conspicuous clusters of crystals of hornblende. It is cut by veins of red gneissic granite, near which the amphibolite contains many large crystals of garnet.

Woodcock Portage has a total length of 1·91 statute miles. It is on the whole very bad, having long stretches of swamp, and steep hills, the sides of which are covered with broken masses of rough sandstone derived from the underlying rock. In the first quarter of a mile the almost imperceptible track leads up the face of a steep cliff of coarse Athabasca sandstone, strewn with sharp angular masses broken from rocky ledges, up which it was necessary to carry the supplies in half loads. A hundred feet up the face of the cliff is a moderately regular terrace, apparently representing an old shore line of Lake Athabasca, when it stood at one of its higher stages. From the top of the sandstone escarpment a magnificent view may be had down the wide valley which we had just ascended from Lake Athabasca. Towards the north rise the rounded Archæan hills, while to the south is the sinuous edge of the high escarpment of stratified sandstone. Between is the gently sloping wooded valley, in the bottom of which Black River winds as a long glittering line of water.

Sandstone cliff.

Marsh and swamp.

From the summit of the cliff of sandstone the portage-track descends into a deep marsh and then passes through a tamarack swamp. It then passes for two-thirds of a mile over a sandy plain in places lightly undulating, wooded with small Banksian pines, to some hills of white sandstone. On the summit of one of these the rock is beautifully smoothed, and shows glacial grooves, trending N. 70° W. From the foot of this hill, a sloping plain extends eastward for 350 yards, declining in this distance thirty feet. The plain is thickly scattered with boulders, chiefly of sandstone, and conglomerate, but some of gneiss. The edge of the plain drops suddenly in a little cliff of clay twelve feet high, to a narrow willow-covered flat on the margin of Middle Lake. About a quarter of a mile to the north, the river flows out of the north end of the lake to the heavy rapids below.

Middle Lake.

Elizabeth Portage.

Middle Lake was crossed in a southerly direction for two miles and a-quarter, to a sandy beach, where the canoes were again unloaded preparatory to carrying everything over Elizabeth Portage. The micrometer survey showed the length of this portage to be 3·52 miles, and the aneroids showed its southern end at Black Lake to be 120 feet above its northern end at Middle Lake. Generally speaking the track is sandy, dry and hard, so that, although it is nearly twice as long as Woodcock Portage, it may be crossed with less difficulty and fatigue, though in bright weather one is tormented by myriads of black flies. No rock of any kind is to be seen on the portage. The following paced survey will give a good idea of the character of the portage, 2000 paces being counted to each statute mile.

From the sandy beach of Middle Lake— Elizabeth Portage.

265 paces over a sandy plain wooded with Banksian pine.
395 " moderately level plain of sand and broken masses of sandstones, wooded with small pine.
250 " across swamp underlain by broken angular masses of sandstone.
400 " gently rising sandy plain, wooded with stunted pines two feet high, to a low sandy cliff, the bottom of which is about fifty feet above Middle Lake.
185 " similar sandy plain about ten feet higher.
75 " to a swift brook twelve feet wide and two feet deep with sandy bottom.
80 " across swamp to sandy bank ten feet high.
1050 " almost level or gently rising sandy plain, open or covered with stunted pines two feet high.
420 " up a slight rise, and over a sandy plain through woods of Banksian pine.
430 " up a similar rise, and over a similar wooded sandy plain.
225 " in a small valley between sandy ridges.
1780 " over a thinly wooded sandy plain, the last 400 paces being along the north side, and at the foot of, a steep wooded slope, at an elevation of about 150 feet above Middle Lake.
420 " along a gravelly slope, with a hill to the south 100 feet high.
485 " through woods of small Banksian pine over sand and pebbles, at the foot of the hill seventy feet high.
430 " over wooded country thickly strewn with boulders. Has all the appearance of a morainic ridge.
160 " down the side of a hill thickly covered with boulders, with a drop of about forty feet, to the bank of Stone River, just where it flows from Black Lake.

The above description shows the existence of extensive post-glacial beaches and sand-plains, from twenty to a hundred feet above Middle Lake, marking higher stages of the whole or part of Lake Athabasca, and they would appear to be closely connected with the morainic ridge at the south-east end of the portage. But whether the glacier from the east stood at this ridge when they were formed, or whether it had then receded further towards the east or north-east, and what connection there is between these beaches and terraces, and the glacier which blocked the valley a short distance east of Fond du Lac, were questions that it was impossible to settle in the time at our disposal. Post-glacial beaches.

Elizabeth Portage is made to avoid a long chain of impassable rapids, the lowest of which, near the foot of the gorge, I have called Elizabeth Falls, from having visited the spot on the birthday of a beloved sister of that name. The river here forms a wild rapid about a mile in length, broken by heavy cascades and falls, eight to ten feet in height. The north bank, thickly wooded with black spruce and birch, rises gently to some distant green hills, the slope being underlain by Elizabeth Falls.

fine-grained dark, reddish, garnetiferous hornblende-gneiss. The south side of the valley is composed of red, horizontally stratified sandstone, which rises in abrupt bare cliffs, often vertical, to a height of 100 feet above the water. Rounded bosses of gneiss also rise in the bends of the south bank, and wooded islands and jagged granite rocks constantly impede and break up the foaming torrent. The total drop here is about eighty feet.

Chloritic gneiss.

A small island lies out in the river at the head of the rapids, and opposite it is a little cliff of greenish fine-grained gneiss, the biotite being much altered to chlorite. It strikes S. 30° W., and dips N. 60° W. at an angle of 75°. A hundred yards further down, the bank consists of masses of coarse amphibolite, for two-thirds of a mile. Beyond this the rock consists of vertical red gneiss, striking S. 30° W., interlaminated with lenticular bands of green amphibolite. Elizabeth Portage ends on the bank of the river close to Black Lake, which has already been described on pp. 50-54. We may therefore pass on to that part of Stone River above the lake.

River above Black Lake.

Where Stone River flows into the south-east side of Black Lake it is about 300 feet wide, and on each side are little rounded hills of sand and boulders wooded with spruce, pine and birch.

Portage.

After ascending the river for three-quarters of a mile, the foot of a heavy fall was reached, and the canoes were landed at a low wooded bank at the bottom of an adjoining bay on the north side, from which point everything was carried over a portage 1017 yards in length, to the bank of the river above, passing three falls in the distance and rising forty-seven feet. The track ascends a steep slope from thirty to forty feet high at each end, and in the middle rises to a height of 120 feet above Black Lake. It passes for the most part over sandy or slightly clayey land, wooded with Banksian pine. Its west end is on low land wooded with spruce and birch, while its east end is in a grove of willows. Opposite the head of the portage the river is about 150 yards wide, with low grassy banks chiefly wooded with black spruce. Just to the west of this willowy spot the banks are composed entirely of red and gray biotite-gneiss, sloping to the water on the north side and broken and craggy on the south.

Between two rocky points, the water first rushes in a smooth sheet over a ledge of reddish-gray gneiss, and then in a foaming cataract for 300 yards between high, bare walls forty feet apart, to a small island where it divides and the greater part of the water flows to the right in a narrow straight gorge with a drop of twenty-five feet. Below

this again the rapids end in a lovely divided fall opposite the lower end of the portage. Seen on a clear bright day towards the end of summer, the falls were perhaps the most beautiful that I had ever beheld.

Light-gray gneiss.

For four miles above this rapid the banks are low and composed of light-gray gneiss, often irregularly foliated and containing many darker irregular inclusions. On both sides of the stream the rock juts out as smooth rounded points, connected with low sandy ridges covered by grass and willows, behind which are small lakes. To the south is a moderately even ridge, probably of sandstone, about a hundred feet high, while to the north are hills of gneiss 150 feet high, which gradually recede as the river is ascended.

Porcupine River.

At a distance of eight miles above the rapid, Stone River is joined from the north by Porcupine River, a large stream of dark brown water, 300 feet wide at its mouth, apparently deep, and flowing with a current of two miles an hour. It is said to take its rise in Selwyn Lake, from which Chipman River also flows, and to pass through a very rough rocky country in deep gorges, in the bottom of which are many swift impassable rapids. On this account, and because Chipman River offers an easier road to the same place, the river is rarely, if ever, used as a canoe-route by the Indians.

Leave the Archæan.

At the mouth of the Porcupine River the Archæan gneisses were left behind, and turning sharply toward the south-west we entered a comparatively level sandy country underlain by the red Athabasca sandstone, similar to the country through which we travelled on our way down Cree River, and like it wooded with Banksian pine and small birch.

Two miles above Porcupine River is a rapid, at the foot of which is an outcrop of three feet of heavily and horizontally bedded red sandstone or fine conglomerate. The rapid consists in all of four fairly distinct dips, between which is more or less swift water, with a bed either of flat-lying sandstone or small rounded boulders.

Heavy rapid.

Above this rapid is a mile of fairly quiet water, beyond which is another heavy continuous rapid, wide and shallow near the bottom, where it flows over a bed of small boulders, and very swift and white at the top, where its bed consists of large boulders. The flats on each side are underlain by rounded boulders, chiefly of sandstone, but some of gneiss, &c. A sloping grassy or stony beach extends from the edge of the woods down to the water, on which the men

walked as they tracked the canoes with a line against the heavy current.

Chippewyan Indians.

About two miles above Perch River, a small tributary from the east, we met several canoes full of Chippewyan Indians descending the river, having come down from Wollaston Lake in three days. They were on their way from Reindeer Lake to Black Lake, where they intended to join other Indians and travel northward to meet the deer near the southern edge of the Barren Lands. As but one of our Indians had ever been on this river before, and that was so long ago that he had now almost entirely forgotten it, we camped beside our new friends from Reindeer Lake, to learn the present condition of the stream, the character of the portages, &c. They also told us something of a canoe-route northward from Reindeer Lake to Kasba or White Partridge Lake, and thence northward down the Kazan River.

Wide river.

The following morning, August 9th, we continued the ascent of the river. For eleven miles it is wide and lake-like, with a perceptible current only at the narrowest parts. The banks are everywhere low and sandy, with a very few boulders here and there. In the protected bays willows are growing to the water's edge. Back from the river a few lenticular hills, or ispatinows, from 100 to 200 feet high, follow the general direction of its banks. In the upper part of the distance these ispatinows close in on the river, and their burnt sides were seen to be thickly strewn with moderately well rounded boulders, chiefly of sandstone, but also of gray gneiss, dark and light green trap, green chloritic schist, &c.

Cliffs of sandstone.

Thirteen miles above Perch River is a rapid a mile in length, with a total fall of about fifteen feet. Like the others it is fairly deep at the top, but wide and shallow at the bottom. The bed of the rapid is filled with boulders. The flats above the rapid are composed of broken fragments of sandstone, mixed with rounded boulders of gneiss. The banks by the lower part of the rapid are vertical or overhanging cliffs from ten to fifteen feet high, of light red coarse sandstone or fine conglomerate, with well rounded pebbles. It shows strong flow-bedding, but the general stratification is horizontal. Here, as elsewhere, fossils were carefully searched for, but none could be found. The surface is for the most part rough, but in one place strong glacial grooves were found running S. 80° W. Above this rapid the river comes from the south for a mile, when it turns sharply and flows from the east between two high steep ridges, the more northern one having its side thickly strewn with boulders, and both being apparently long ispatinows. Looking eastward the cone-shaped ends of other ispatinows were seen in the distance.

Five miles above the bend, Hawk-rock River, a swift clear stream fifty feet wide and two feet deep at its mouth, flows into the south side of Stone River, down a rapid with a descent of two feet, discharging from a small lake a quarter of a mile across, into the opposite side of which it falls in a wide shallow rapid. It seemed to come from about S. 10° W. Ithingo, one of our Chippewyans, said that it has high banks of sandstone, and that there is a practicable canoe-route up it, across into the east branch of Mudjatick River, and down Mudjatick River to the Churchill. Many rounded boulders are lying on the beach at its mouth, most of which are of gray gneiss. Hawk rock River.

Hawk-rock Rapid, just above the mouth of Hawk-rock River, has a fall of from eight to ten feet. In its upper part the banks are composed of ten feet of reddish sandstone similar to that already seen. Its surface is well marked by glacial grooves, trending S. 65° W. Hawk-rock Rapid.

From the head of this rapid, for a mile and a-quarter, is a stretch of quiet water, with banks of sandstone up to thirty feet or more in height. The next rapid is in two chûtes, both short. The canoes were tracked up the lower, and poled up the upper chûte. On its south side a narrow ridge of boulders from fifteen to twenty feet high runs parallel to the bank, and is scarped by the swift current. All the boulders are rather small and well rounded, and they are bedded in a very scanty matrix of sand. Probably the ridge is a small esker.

Moose Lake, is a quiet expansion of the river just above this rapid, with a length of six miles and a-half, and a width of from a-quarter to a-third of a mile, having the appearance of a large river. The immediate banks are generally low and sandy, but above them the steep wooded side of the ispatinows rise to heights of 100 to 200 feet, forming a regular even valley. These hillsides are usually sandy, scattered with rounded boulders of gneiss and sandstone. Moose Lake.

The river flows into the east end of Moose Lake in a heavy rapid, nearly a mile in length, and divided into two channels by a large island. It is called by David Thompson "Brassey Falls." At its foot is a wide bottom-land composed entirely of boulders, chiefly of reddish-gray gneiss, though some are of sandstone, and a few are of Huronian rock, probably transported from the area of Huronian rock in the vicinity of Kasba Lake, discovered in 1894. These Huronian boulders consist largely of coarse conglomerate, and white quartzite. Brassey Lake.

A point on the bank is covered with small balsam poplars, the first seen above Black Lake. Berries were very plentiful, the most abundant being the northern huckleberry (*Vaccinium uliginosum*) and the cran- Berries.

berry (*Vaccinium Vitis-Idæa*), while the common huckleberry (*Vaccinium Canadensis*), red and black currants (*Ribes rubrum* and *R. Hudsonianum*), gooseberries (*Ribes oxycanthoides*), crowberries (*Empetrum nigrum*), Pembina berries (*Viburnum pauciflorum*), etc., are also found.

Hill of sandstone.

To the south of Brassey Falls is a hill fifty feet high, consisting of white Athabasca sandstone, dipping N. 20° W. at an angle of 10°. Its summit is well smoothed and grooved, the grooves running S. 80° W. This ridge of sandstone strikes the river at the head of the rapid, and the banks and the bed of the stream below are composed of large rounded boulders, over which the men struggled with great difficulty, as they walked beside the canoes and hauled them up the current.

A mile above Brassey Falls, a cliff of sandstone fifteen feet high rises on the north bank to the edge of a wide sandy plain. Opposite to it, on the south side of the river, is a very steep bank 100 feet high of sand and boulders. On ascending this bank it is found to be the side of a knife-edged ispatinow about a mile long, composed of sand and large and small boulders, chiefly of gneiss. The summit is very narrow, and the sides are as steep as the material will stand.

Brink Rapid.

A short distance farther up the stream we ascended Brink Rapids, a mile long, with a total descent of about twenty-five feet, tracking and poling up the lower part, and making a portage on the north side past the upper part, where the water rushes over several ledges of sandstone. The banks are low cliffs of sandstone, and a ridge of sandstone stretches along the north side of the river.

Annoyance from black flies and mosquitoes.

On the evening of August 10th, camp was pitched near the east end of the portage. The black flies, which breed in the clear running water, had for some time past been swarming around us in countless numbers, and had turned every moment of warm sunshine into a moment of agony. At night, rolled in our blankets, under a tent of cheesecloth to keep off the mosquitoes, we secured a few hours' rest. Most of the rapids had been ascended by walking in the water and hauling the canoes, and in order to get a foothold on the smooth stones and to stem the swift current, the men were often naked up to their waists, and consequently suffered very severely from the black flies.

Above this camp the north bank of the river is formed by a high ispatinow, and others rise at a short distance back on the south side. The immediate banks are composed of flat-lying sandstone. At a distance of a mile and a-half up the river, on the south bank, is a

hill of similar sandstone forty feet high, striking N. 30° E. and dipping N. 50° W. at angles from 20° to 40°. Two hundred yards farther up stream the sandstone is again horizontal. The river continues in a straight course from east-southeast for three miles, with a moderate current, between sandstone banks, and then turns sharply from the south, around a sandstone hill, on the east side of which is a beautiful cliff seventy feet high, where a pair of golden eagles (*Aquila chrysætos*) have had a nest for a number of years.

Sandstone banks.

The river flows from the south for a mile, between banks of sandstone from ten to twenty feet high, when it again turns and comes from the east for five miles, in the bottom of a wide swampy valley between long lenticular hills of boulders 200 feet high. No rock shows on its banks. At the end of the five-mile stretch of quiet water, the river again turns sharply and flows from the south down a swift rapid with a fall of fifteen feet, up which we tracked the canoes on the north side. The bed of the rapid is composed entirely of boulders, which are probably resting on a bed of sandstone. On the south side is a cliff showing forty feet of horizontal sandstone, while on the north side is a wide flat of large rounded boulders. From here, swift water or rapids extend for three miles up to the foot of Manitou Falls, high scarped banks of sandstone overlooking the stream here and there.

Manitou Falls.

Manitou Falls was so called by the Indians because the water in one of its channels disappears under the rock for a short distance. The water tumbles over the face of a rocky sandstone ledge in two streams, into a narrow channel about twenty-five feet wide, from which part of the water rushes to the left in an open channel, while a part runs for about twenty yards under the rock, both streams falling into a wide, shallow, rocky basin below. The fall is fifteen feet in height, and past it is a portage 120 yards long on the south side. Here our camp was pitched, on the evening of August 11th. Towards the north-east an elongated oval hill of glacial débris rises above the sandstone to a height of 150 feet, wooded to the top. The estimated fall in the river showed the foot of Manitou Falls to be about 150 feet above Black Lake.

From the head of the falls we ascended the river with paddles, against a very swift current between perpendicular sandstone walls fifteen to thirty feet in height, to a portage on the south side 730 yards long.

Portage.

The portage first ascends a rough sandstone hill thirty-five feet high, and then passes through pine woods over fairly level country. North

of it the river has a fall of about fifteen feet in a heavy rapid between sandstone banks.

Immediately above the portage the channel is very crooked, and there is a stiff rapid with a fall of about twelve feet, which we ascended with a line, above which is a stretch of moderately easy water, up which we paddled, with the assistance of a stiff breeze, to the foot of Thompson Rapid, one of the heaviest rapids on the river. The lower part, in which the banks are low, was readily ascended with a line to a short portage, thirty-five yards long, across a point on the north side, where we camped on the night of August 12th. Above this short portage, almost to the top of the rapid, the banks are from ten to fifteen feet high, and consist of flat-lying sandstone, generally undercut by the water. Past part of this cascade we portaged all our stuff for 300 yards on the north bank, merely tracking up our empty canoes. The total fall in the rapids is about thirty feet.

Thompson Rapid.

It was here, on the 9th of July, 1796, that David Thompson, the famous geographer and explorer of north-western America, and afterwards the British astronomer on the International Boundary Survey, was upset from his canoe, and lost all his guns, ammunition, food, clothing, and the records of his trip, and on the sandy beach in the little bay at the foot of the rapid he doubtless hauled out his broken canoe.

On the north side of the rapid is a thickly wooded high hill, probably an ispatinow.

Thompson Rapid is sixty miles above Black Lake, or almost midway on Stone River between that lake and its source in Wollaston Lake. To here the river has flowed with an almost constant current, in a well defined channel. From this point upwards there is less detrital material overlying the rock, the river widens out in places into small lakes, between which are shorter or longer stretches of narrow stream.

Change in character of river.

Above Thompson Rapid, the river opens into a small lake two miles long, with high hills to the north, wooded down to the water's edge, while pleasant sandy beaches extend along the south side, with hills of boulders from fifty to seventy feet high in the background. The only rock seen was in two little cliffs of sandstone near where the river flows from the lake.

Small lake.

From this lake we ascended the stream, at the mouth of which is a stiff rapid with a fall of six feet. We tracked up this rapid, and

paddled up another light rapid with a drop of two feet, to the western arm of Otter Lake, and then for three miles and a half through this beautiful little lake, whose shores are low points or wooded hills, to the mouth of the river, where it flows into the south end of the lake over a bed of small boulders in a wide shallow stream. The boulders are almost all gray gneiss. Just within the mouth of the river, in a deep bay, empties a small stream eight feet wide, falling four feet in a little stony rapid. It flows from a lake half a mile long running N. 70° E. Otter Lake.

For a mile and three-quarters up the river, to Perpendicular Rock, the current is swift all the way, and most of the distance was ascended with the line. The banks are for the most part low, and composed of boulders, though at two places sandstone was seen.

At Perpendicular Rock, the stream is moderately narrow and swift, with overhanging cliffs of sandstone fifteen feet high on each side. The cliff on the north side, is the face of a small isolated hill of sandstone, an old channel of the river extending behind it. The cliff on the south side is much longer, and back from its summit were found some smooth well glaciated surfaces, the glacial grooves on which run S. 55° W. Perpendicula Rock.

From Perpendicular Rock the rapid stream was ascended for three-quarters of a mile to a point where it breaks into several channels. In the channel followed, are two rapids with drops of ten and five feet respectively. At the first are overhanging banks of sandstone fifteen feet high, while at the second the banks are low. Above the latter is a fine stretch of good water for three miles and a-half, with a little rapid about the middle, to the Elbow. Here the main channel continues eastward into a deep bay, but the river falls directly into the south side of this channel in a heavy, though not very long rapid called Red Bank Falls. On the east side of this is a low scarped bank, showing six feet of more or less thin-bedded red sandstone and conglomerate with white quartzite pebbles. Above this heavy rapid are two short stiff rapids, at narrows in the stream, before Kosdaw Lake (so named after one of David Thompson's Indians) was reached, on the west shore of which we camped among pines on a little knoll of sand and boulders, on the evening of Saturday, August 13th. Red Bank Falls.

Kosdaw Lake is about five miles long, and a mile and a-half wide, broken by several large islands, and with the river flowing into its south-eastern and out of its north-western side. It is surrounded by low wooded hills, the woods almost everywhere descending to the edge of the water. A few sand-beaches run along the shore near the mouth of the river, but none of the underlying rock is to be seen. Kosdaw Lake

Stone River falls into the lake in a rapid a mile in length, with a total descent of twenty feet. Its lower part is rather shallow, and was ascended with poles; the upper part is deeper, and was tracked on the north-east side. The banks are for the most part low and composed of boulders, but near the top the left bank shows thick-bedded sandstone, with a very much broken surface. Just below this outcrop of sandstone a brook ten feet wide flows in from the east, over a bed of boulders.

Swift stream. For the next two miles and a-half, to a lake, the current is very swift, and the stream was ascended by tracking or poling. The banks are generally low, with willows to the edge of the water, and no rock was seen, though broken sandstone is common near the bank.

The lake is narrow and three miles and a-half long. The most of the shores are low, with very low hills in the background, but at the south end is a high well-rounded elongated oval hill.

For a mile above the lake, to a portage, the river is rapid, and we ascended it with poles. At the portage the current is very swift, with heavy waves, and the Indians usually carry their canoes on the south side for 480 yards. However, we walked in the water, and hauled our canoes up along the south bank, inside the heavy waves. At the foot of the rapid, on the north side, is a little rounded *roches moutonnées* hill of white sandstone, while on the south side is a hill twenty feet high, composed chiefly of boulders of red and gray gneiss. The adjoining country consists of rounded hills thickly wooded with spruce.

Morainic hills. Just above the rapid the traveller ascending the river enters a desolate country, of low, almost bare hills from fifty to seventy feet high, composed of boulders imbedded in a matrix of barren red sand. Low hills of sand are also scattered among those of boulders, and beside them the banks of the river are sandy. These stony hills indicate a morainic area in which are scattered sandy kames. The river traverses this morainic area for eight miles, spreading out in the middle of the distance into a long narrow lake, on the banks of which are some horizontal outcrops of coarse white sandstone.

A hill on the south-west shore, which was more particularly examined, is seventy feet high, with a summit of barren sand scattered with boulders. On its side, twelve feet above the lake, is a terrace of

Old shore-lines. boulders, and fifteen feet higher is a steep bank of boulders, both denoting old shore-lines. From this hill a deep bay extends in a south-westerly direction towards the mouth of Waterfound River. At the bottom of the bay are several well rounded, lightly wooded, drumlin-like hills.

Two miles above this hill, and a mile and a quarter below the next rapid, we camped on the south bank, on a low boss of flat-lying sandstone, which extends from the bend in the river back to a narrow lake or old river-channel. Its surface, though generally rough, is scratched and grooved by glacial markings running S. 45° W., the stoss and lee sides of the rock being clearly shown. The lake, back of camp, is about a mile long, and lies in a narrow valley running S. 45° W., the north-west side of which is composed of a ridge of boulders thirty feet high, and between 200 and 300 yards wide. On this ridge the boulders are chiefly of red and gray gneiss, but some are of Huronian conglomerate, white and gray quartzite, crystalline dolomite, etc. West of this boulder ridge, are two other small lakes through which Waterfound River flows. Between the lakes it is fifty feet wide and eighteen inches deep, flowing swiftly over a gravel bed. Up this river there is said to be a canoe-route to Churchill River, crossing the height of land, and passing down Haultain River. A short distance above the mouth of Waterfound River, a stream joins the Stone River from the north, forty feet wide at its mouth, where it flows in a shallow rapid over a bed of boulders.

Ridge of boulders.

Waterfound River.

The next rapid is very swift, with a drop of about ten feet, and up it the canoes were taken by hand. Stone River is now much reduced in size, being only between eighty and one hundred feet wide.

Three-quarters of a mile farther up the stream is another swift rapid, up which the canoes were also taken by hand, although the Indians commonly carry their canoes on the south bank for 1000 yards. The bed of the stream is of boulders, but the horizontal sandstone has formed the banks more or less continuously from the mouth of Waterfound River to here. This was the last outcrop of Athabasca sandstone seen in the ascent of this river. Since leaving Black Lake all the outcrops have been very similar in character, generally horizontal and undisturbed, and none showing any great thickness. Beyond Crooked Lake, which lies just above, the Archæan granites and gneisses again come to the surface. Crooked Lake is a narrow, winding body of water, through which we travelled for seven miles. The water is clear but dark, and seems to be rather shallow. The shores of the lake are low and stony, and are covered with a thick growth of willows that overhang the water. A few sparsely wooded hills about sixty feet high rise in the background.

Last outcrop of Athabasca sands one.

Crooked Lake.

Stone River empties into the east end of the lake in a heavy cascade, with a fall of about twelve feet, over a rounded ridge of rather coarse, red biotite-granite, heavily jointed and massive, except for an occasional

Laurentian granite.

slight horizontal foliation. Crooked Lake, therefore, lies along the line of junction of the Archæan granites and gneisses and the overlying Athabasca sandstone. A portage 360 yards long leads past this fall across a bend on the south side, at first through swamp, then over boulders, and finally over a granite knoll wooded with small spruce. In the next mile are two rapids with drops of six and eight feet respectively, over large boulders. At the upper one the banks are composed of red granite similar to the last, but finer grained and generally foliated. The canoes were carried past it on a rough portage 370 yards long on the south side over a rounded hill of gneiss, the surface of which is broken and irregular. Above the portage is a small lake

Red gneiss.

with high bold shores of red gneiss. On the evening of 16th August, camp was pitched in a little sandy bay on the south side of this lake, at the foot of some rounded hills of boulders. The latitude as determined was 58° 40′ 47″

From this lake we ascended a heavy rapid over boulders to Hatchet Lake. The rapid has a total fall of about eighteen feet. At its foot the descent is very steep; near its head it is divided into two channels by an island, and the men hauled the canoes by hand up the north channel. At the head of the rapid the south bank is formed of red granite, while the north bank consists of boulders on the edge of a very wet spruce swamp.

Hatchet Lake.

Hatchet Lake is a small rectangular body of clear water, with a greatest length of twelve miles, a greatest width of seven miles, and a shore line of thirty-nine miles.

South shore.

Mr. Dowling surveyed the south shore, and found it to be composed chiefly of boulders, with occasional outcrops of reddish gneiss at the points.

North and east shores.

The writer surveyed the north and east shores, which were found to be generally low, with beaches covered with boulders, alternating with occasional stretches of sand in the bottoms of the bays. Behind the beach is a low wooded country, with some rounded hills in the distance. The points on the north shore are underlain by massive red granite, or reddish-gray gneiss. The east shore is composed of a massive medium-grained white biotite-granite rich in plagioclase.

Glacial striæ were observed both on the east and west shores, in both cases running S. 25° W.

The islands in the lake are generally low and underlain by red granite. But near the north-west angle some stand out higher than

the others. One of these was more particularly examined, and was found to be an esker or narrow lenticular hill 70 feet high running S. 25° W. parallel to the glacial striation. It is composed almost entirely of loose sand, mingled with a few well-rounded pebbles and small boulders, up to ten inches in diameter. Its west face is scarped where it overlooks the lake. East of the main ridge of the esker is a little valley, beyond which, on the same island, is another lower parallel sand ridge. On top of the esker are some fine tall white spruces, as much as six feet in circumference, forming very conspicuous objects in this country which is generally wooded with small black spruce. Esker.

On our arrival at Stone River, which empties into the south-east corner of the lake, Mr. Dowling had not yet arrived, so we determined to continue the ascent of the stream and wait for him at Wollaston Lake. Stone River.

Wooded hills, probably of boulders, rise on each side of the mouth of the river.

A mile above its mouth the river turns sharply, coming from the south, and winds for three-quarters of a mile through a marsh, to a rapid over boulders, with a fall of three feet, up which we poled without difficulty. From here the river has an even width of from sixty to eighty feet, and flows with a current of about two miles an hour through a marsh or grassy meadow. Back from the river are some low wooded hills of sand or boulders. The next rapid has a drop of about six feet, and was easily ascended with poles. Above this rapid the river gradually widens, and the banks are mostly low, with low hills of boulders back from the river. A small island a mile below the rapid was found to consist of red biotite-granite, with a slight foliation in some places, and farther north a hill about a hundred feet high seemed to be composed of white granite. River sixty to eighty feet wide.

For four miles above this island the country is low and without rock exposures, and the river is wide except at one point, where there is a swift current. At the end of this distance a rounded hill, sixty feet high, stands out conspicuously from the north bank into the middle of the stream. It consists of a reddish-gray biotite-gneiss, foliated N. 65° E. and with a dip varying from vertical to a high angle S. 25° E. It is heavily jointed approximately at right angles to the foliation, so that its south face forms a very precipitous cliff. Two small islands, and a point on the south shore a mile and a quarter above this cliff, are also composed of similar gneiss, while the north bank opposite is a steep cliff of sand and boulders. A short distance above the latter Hill of gneiss.

Rock disappears.

point the rock disappears, and from there upwards to Wollaston Lake the banks are lined with boulders. At the point where the river flows out of a bay at the north-west corner of the lake, it is rather narrow, and has a moderate current. The bed of the stream could not be seen, but the banks were composed entirely of sand and boulders.

Wollaston Lake.

Area.

Wollaston Lake is a large body of beautifully clear transparent water lying in a general north-and-south direction, with a greatest length of about fifty-five miles, and an approximate area of 800 square miles Its contour is exceedingly irregular, its shore-line being indented by deep bays, and its surface dotted with numerous rocky islands. Two tributaries were discovered flowing from the south-west into its western side, while it holds the unique position, for so large a lake, of being drained by two almost equal streams which flow in opposite directions. Stone River, one of these, has just been described from where it flows out of the north-west angle of the lake to its mouth in Lake Athabasca, where its waters join those of the Mackenzie River and are carried northward to the Arctic Ocean. Cochrane, or Ice River, which was first ascended by the late Mr. A. S. Cochrane in 1881, flows from the north-eastern angle of the lake, and after a course of 200 miles empties into Reindeer Lake, from which the water flows by Reindeer and Churchill rivers into Hudson Bay. The name Cochrane River is proposed for this stream instead of Ice River, to avoid confusion with Icy River, which flows into Great Fish River, and as a fitting tribute to the memory of my friend, Mr. Cochrane, who was the first white man to ascend and survey the stream, and to set at rest the question whether Wollaston Lake is drained by two streams, as marked on David Thompson's map, or by only one, as positively asserted by Abbé Petitot.

Drained by two rivers flowing in opposite directions.

Cochrane River.

North-west bay.

The bay of Wollaston Lake, from which Stone River flows, is a mile and a-half long and three-quarters of a mile wide, and on the east side of it we pitched our camp on the evening of the 18th of August, to wait for Mr. Dowling. The latitude was determined as 58° 26′ 44″, and the variation of the compass to be 27° east. The shore is generally lined with boulders, but there are a few little stretches of sand, at one of which we hauled up our canoes. Behind camp a low ridge composed of sand and boulders of granite, well wooded with spruce and Banksian pine, runs southward to a low prominent point that appeared to be a favourite Indian camping ground.

Mr. Dowling arrived on the following morning and shortly afterwards we started southward down the west side of the lake. The beach is a line of boulders, behind which the country is low and wooded with small black spruce. Three miles south of the head of Stone River, is an esker-like ridge of sand and boulders between 200 and 300 feet high, lightly wooded with Banksian pine. Behind a little sandy bay near its south end, a deep mossy bog stretches up a gentle slope to the edge of a terrace of rounded gravel sixty feet above the lake, marking an ancient lake shore.

West shore of Wollaston Lake.

Esker.

A mile south-east of this sloping bog a long and narrow island lies in the mouth of a rounding bay. It is made up of very steep esker-like hills and ridges seventy feet high, of sand and well rounded boulders, between which are deep kettle-holes, occasionally containing small ponds. The sides of the hills are as steep as the sand will stand, and their bases are fringed by rings of boulders.

Following the shore onwards for four miles, the first rock in place met with was on a small island of red granite. The granite is composed chiefly of orthoclase and quartz, with a little plagioclase and biotite and contains some inclusions of foliated gneiss. The surface is smooth, but, like most of the rock-surfaces in this region, it is not striated:

Red granite.

Absence of striæ.

For ten miles southward, to the mouth of Collins Creek, no rock was seen in place, but the shore is mostly strewn with boulders, many of which are of Athabasca sandstone and conglomerate. Behind the beach is a rather steep slope, rising from ten to twenty feet, to a sandy plain wooded with Banksian pine, similar to the plain on the west shore of Cree Lake. Many of the sandstone masses are quite angular, and their presence here, and not farther north, taken together with the general sandy character of the surrounding country, is conclusive evidence of the occurrence of Athabasca sandstone in the immediate vicinity. The occurrence of the sandstone here shows that this lake, as well as all the other large lakes through which we have passed, lies along the line of contact of the Archæan and Palæozoic rocks.

Athabasca sandstone.

Collins Creek is, at its mouth, a small stream forty-five feet wide, running over a bed of boulders. Its water is of a light-brown colour, and its banks are grown with spruce and willows. It flows into the bottom of a long narrow bay with beaches of sand and boulders.

Collins Creek.

We followed the low east shore of Collins Bay outwards for six miles, to a point behind which is a high rounded hill of dark-gray well foliated biotite-gneiss, striking N. 20° E. and dipping S. 70° E. at an angle of 50°. In some places it is very coarse, and full of biotite, and

Point of gneiss.

is much broken by irregular veins of coarse red pegmatite. Its surface is smooth, and shows strong glacial grooves, trending S. 10° W.

White granite.

Two miles and a-half farther around the shore, is a long point of massive, coarse white granite, containing inclusions of dark biotite-gneiss, while just behind is a high rounded hill of dark-gray biotite gneiss striking N. 45° E. and with a vertical dip.

From the top of this hill a magnificent view may be had of the lake. Towards the north and east it is dotted with many islands, while towards the south is an extensive stretch of clear blue water. Its shore-line is very irregular, and behind it rise low, gently sloping hills thinly wooded with spruce and pine, often separated by extensive swamps wooded with small spruce and larch.

From this place we struck southward, at first past some points of white granite, and then for five miles straight across the open lake to the east point of a large wooded island, composed of greenish-black thinly foliated, fine-grained hornblende-biotite-gneiss, striking N. 45° E. and dipping S. 45° E. at an angle of 75°. Interlaminated with the gneiss are some bands of white quartz. The surface is smoothed, and on the summit are glacial grooves trending S. 15° W. In the last stretch, the water in the lake was found to have an average depth of twenty-eight fathoms, with a greatest depth of thirty-two and a-half fathoms. From this island we crossed for three miles, to a small bare island of massive very coarse white granite, consisting chiefly of quartz and orthoclase, with a small quantity of biotite, and black tourmaline in large crystals. A mile and a-half farther on, is a large island of similar white, but finer grained, granite. Two miles farther is a long bar of boulders, forming the north point of a very large rocky island or peninsula. A mile and a-half farther south, we camped on a boggy spot at the foot of a hill on the south side of a point, in north latitude 58° 7′ 40″. The hill is 250 feet high, and is composed of a coarsely granular red biotite-gneiss foliated N. 65° E.

Hornblende-biotite-gneiss.

Depth of water.

For nine miles farther south, the shore is very irregular and composed of similar reddish gneiss rising in hills from 100 to 300 feet in height, with a fairly persistent strike, N. 40° to 65° E. The summits and south-west sides of many of these hills are covered with sand and boulders. Wherever glacial striæ were observed they trend S. 30° W.

From here we turned south-westward for eight miles, along the strike of the gneiss, in a channel from a mile to two miles wide, between a large island to the east and the low shore to the west, but whether of a large island or of the mainland was not determined. This shore is

Low shore.

thickly strewn with boulders, and low exposures of reddish-gray gneiss were seen at but a few places. Some wooded islands lying off the shore are low and chiefly composed of boulders.

From the end of this channel we struck westward, past some red granite islands piled around with boulders, to a sandy beach where Indians had lately been camped. High sand-hills rise here and there, and banks of sand, being sections of these sand hills, occur at various places along the shore, but their faces are so covered with talus that nothing could be determined from them as to the structure of the hills. Among the pebbles found on the beach was one of white crystalline limestone. Sand-hills.

From this sand-beach we turned eastward for two miles and a-half, to a point, and then southward down the west shore of Nekweaza Bay, which is fourteen miles in depth. The shore is composed of similar red granite and gneiss, and some of the islands lying off it are narrow esker-like ridges of sand. On the evening of August 23rd, camp was pitched on the shore in north latitude 57° 48′ 48″ on a gravel beach ten feet above the lake. Just behind the camp was an old gravel shore-line five feet higher. Towards the south-west was a swamp lying on a bed of boulders, beyond which was a high rounded hill, wooded with spruce and pine. Its centre consists of a reddish gneiss, while almost all the surface is covered with a fine reddish sand or silt, holding a large number of rounded boulders. Nekweaza Bay.

The next morning we travelled down to the southern extremity of Nekweaza Bay, where it ends in a wide marsh. We retraced our course for a short distance, and then turned westward for four miles, into an irregular arm of the bay, near the bottom of which we found a small band of Chippewyan Indians in camp, living on the fish they could catch in their nets, and what partridges and ducks they were able to shoot. We inquired from these Indians about any available canoe-route from this lake through the unexplored country southward to Churchill River. They informed us that a river flowed into this bay a short distance south of their camp, and that many years ago Indians used to travel up this river and cross to a tributary of Churchill River, but that it had not been used for a long time, that many forest fires had doubtless killed much of the timber, that the portages would be blocked up by windfalls, but that they could not give any certain information as they had never travelled over the route. This information was rather dispiriting, but at least it told us of the existence of a river flowing from the south, that had been followed to the source of one of its branches from which a passable tributary of Churchill River was not far distant. Indian camp. Route to Churchill River.

Division of the party.

It was decided to divide the party. The provisions, about ten days' rations per man, were apportioned to each. The writer took one canoe, with the three men employed at Ile à la Crosse, who, after considerable hesitation and an evening's talk over the matter among themselves, agreed to accompany him, and began the ascent of the river, here called Geikie River, in honour of Professor James Geikie, of Edinburgh, who has done so much to foster the study of glacial geology. Mr. Dowling took two canoes and four men, with instructions to follow the south shore of Wollaston Lake, and David Thompson's Canoe River to Reindeer Lake, where supplies could be obtained at the Hudson's Bay Company's post. Thence he would continue the survey southward to the south end of Reindeer Lake, down Reindeer River to its junction with the Churchill, and up that river to Stanley Mission, connecting with the survey of the river previously made by Mr. Fawcett, of the Dominion Lands Branch of the Department of Interior. From Stanley he was to continue southward by Lac la Ronge, and the Montreal River to Prince Albert.

Mr. Dowling's report.

The following is Mr. Dowling's account of the work done by him on this journey:—

Islands at mouth of Nekweaza Bay.

"Nekweaza Bay, running south-westward to the mouth of Geikie River, is broken on its western side by many smaller bays, but its eastern side seems to be more regular, and part of the shore near the main lake is nearly straight, terminating at the north in a low point, off which is a series of long low narrow islands. Down the centre of this bay, a string of islands stretches from near the mouth to the eastern shore at the bottom of the bay. Those which were visited seemed to be made up entirely of drift, and, judging from their shape, many of the others are of like material. They lie S. 25° W., with their longest diameters nearly parallel and approximating to the general direction of the glacial striæ. The striæ observed on the eastern shore run S. 30° W., or more nearly parallel to the side of the valley.

Glacial striæ.

"Several of the low narrow islands off the point and in the bay to the east, are also of drift and have the same general orientation. The larger ones and the main shore are of Archæan gneiss and granite, and have bold shores.

Hills bordering south shore of Wollaston Lake.

"The hills bordering the south shore of the lake are high, but slope gradually from the beach, with the exception of those at the entrance to Compulsion Bay, where they are much steeper, rising to nearly 200 feet. East of the bay higher hills are seen, some probably reaching 400 feet above the lake.

"The rock exposures near Geikie River are of dark-gray gneiss, foliation running S. W. to S. 55° W., but near the mouth Nekweaza Bay this is broken into by a red unfoliated granite and thence eastward the granite seems to have replaced the darker rock, though in places a slight foliation was noticed." Gneiss and granite.

Wollaston Lake to Reindeer Lake.

"The country between these two lakes was traversed on the canoe-route which leaves the south-eastern end of Wollaston Lake, crossing a series of small lakes to the head-waters of a small stream, Canoe River, flowing to Reindeer Lake. The general character of the country is rough and rocky with little soil, and in the valley of the Canoe River showing a considerable deposit of sand. Between the head-waters of this stream and Wollaston Lake, the lakes crossed appear to occupy a low strip of land, bordered on the south by a continuation of the high rocky ridges of the south shore of Wollaston Lake, and on the north by several high hills, forming thus a wide valley opening to the east. The general level of this lake country is but slightly above that of the western lake but forms a plateau sixty feet above Canoe River at the point reached on the route. Character of lake country east of Compulsion Bay.

"The portages on the lake portion of the route are nine in number, and, enumerated in order from the westward, are as follows :— Portages on canoe route from Wollaston Lake to Canoe River.

(1.) Portage 300 yards, from east side of Compulsion Bay to a small lake thirty feet above Wollaston Lake.

(2.) Portage 1200 yards, mostly through swamp, but crossing a ridge of slightly foliated granite. The lakes at either end appear to be at about the same elevation.

(3.) Portage 1550 yards. This crosses a ridge of dark gneiss similar to that on the west side of Wollaston Lake. The country here is well covered with boulders, many appearing on the trail and through the burnt country.

(4.) Portage, in low water made over a narrow strip of swamp, separating a small narrow lake from a larger one to the east, called Middle Lake. This lake lies in a north-and-south direction, divided into two parts by a large island. The extreme length is about five miles and it varies in width from a mile or more at the north end to half a mile to the south. There seems to be lower country to the east, and it is possible that this lake drains to the Canoe River, though its outlet was not seen. The succeeding lakes are all on a lower level, Middle Lake.

and the intervening barriers in a great measure appear to be of boulders and sand.

(5.) Portage, 900 yards. A ridge twenty feet high separates Middle Lake from the next lake to the east, which is nearly twenty feet lower. The barrier is composed of boulders and small stones, and may allow the passage through it of the surplus water from Middle Lake.

(6.) Portage, 200 yards, to the western side of a shallow pond, dotted with large boulders.

(7.) and (8.) Portages cross narrow strips of low country separating three lakes, draining to one another and to the Canoe River.

(9.) Portage, 530 yards, from the last lake of the chain to the Canoe River. The lake is situated on the edge of the valley and is sixty feet above the bed of the stream. A small rivulet trickles down the slope, oozing out through the boulder and gravel-strewn margin of the lake, and joins the stream just above the portage camping place.

Valley of Canoe River.

"The valley of the upper part of Canoe River is cut through a sandy plain which appears to be the surface of a deposit of considerable depth, hiding nearly all the underlying rock except the tops of what appear to be granite ridges. A distance of five or six miles down the stream to the south-east brings us out of this sandy country, and then the river traverses a low swampy flat by many crooked windings till it joins a small lake variously named Swan Lake or Martin Lake. From the hills at the eastern side, the country to the west has the appearance of a rough ridge, smoothed in outline by the sand deposit which seems

Sand terrace.

to be in the form of a belt or terrace running north and south flanking the eastern edge of the high country.

"To the east, between Swan Lake and Reindeer Lake, is again a rough rocky country, but at a general level much below that of the head-waters of Canoe River. Through this the stream follows an irregular depression or valley, falling over many ledges of rock or barriers of

Gneiss of lower part of Canoe River.

boulders. Fine reddish gneiss is seen along the eastern side of Swan Lake, terraces of gravel and sand are cut through by the river below the outlet and at the second rapid dark hornblende-gneiss is exposed in small ledges. The lower part of the valley is covered by a thick coating of glacial débris and no exposures of rock were noted.

Fall in river.

"The fall in the river, from the highest point reached, is estimated as about forty feet to Swan Lake with an additional eighty feet to Reindeer Lake.

"Middle Lake is estimated as standing at about 200 feet above Reindeer Lake."

Reindeer Lake, west shore.

"By reference to the map it will be seen that this lake, which is very extensive and of large area in its northern part, becomes narrow towards the south, ending in a long arm filled with islands. The total length, from the outlet to the Hudson's Bay Company's post at the north end, is more than 135 miles, while the width of the northern part averages 30 miles. The shores generally are flanked by a very numerous array of islands of all sizes, and a string of islands reaching from Vermilion Point on the west to Porcupine Point on the east, divides the northern part into two large portions in which other islands are seen dotting the more open spaces. The whole of the western shore is of a rough, rocky character. The uneven surface of the Archæan rocks though glaciated and the hills partly rounded, is clearly shown by the number of islands scattered all along the shores. The surface of the country at the north is very poorly wooded and islands and several hills appear as bare rocks. A slender growth of black spruce and small birch is, however, found to the extreme northern limit of the lake. The western shore, southward from near Canoe River, is fairly well wooded, though the soil is thin and is found mainly in the lower parts.

General description.

"The rock near the north-eastern part is chiefly a red granite. On the western shore a reddish granite-gneiss with large porphyritic crystals of felspar is the prevailing rock. The foliation runs about south-west, though local variations from this are found. Bands of a whitish granite, which may be intrusive, are seen on some of the small islands, as well as dark dioritic patches which also appear to be intrusions. On the east side, the same granitic-gneiss was seen, and near Porcupine Point the foliation is more distinct, the large crystals of felspar being arranged more in the form of interrupted bands. Intrusive veins of a light flesh-colourd pegmatite cut the gneiss. The same intrusive granite is seen again on a point at the west side sixteen miles north of Priest's Point. It is in the form of a large boss, and is coarse in texture, with the peculiar arrangement of the quartz which gives the appearance of graphic granite.

Granite-gneiss of northern part of lake.

Intrusive granite.

"The western shore from Vermilion Point was followed southward, so that the eastern shore is still indefinite. The numerous islands are nearly all bosses of rock more or less rounded by glacial action and covered with a slight growth of small spruce, the immediate surface

West shore south of Vermilion Point.

back from the water-mark being generally carpeted with a thick growth of the light yellow reindeer moss. Though these islands are usually high, the main land is generally still higher, and often the main shore is easily traced because bare from forest fires, while all the islands, with a few exceptions, are still green. To the south, and especially in the narrow portion, both the hills forming the mainland on both sides and the islands, appear to rise higher than at the north, giving that part of the lake a very picturesque appearance. The timber also, in the south, is of a more varied nature. There, spruce, poplar and birch are found, but north of the middle of the lake, poplar is rarely seen and the small spruce is the principal tree.

Timber.

"The rocks at Vermilion Point are of spotted red granite-gneiss, which extend northward to the limit of the lake and appear in about the same position, the beds standing at a high angle running S. W. and N. E. At Thompson Island, the largest and highest south of Vermilion Point, they give place to a series of hornblende-mica-gneisses, followed on the point to the south by finer, laminated beds approaching schists. These to the east are found to alternate with granite, and for a considerable distance south, to near Priest's Point, the rock is a banded series of granites and thin beds of mica-schist broken into by the graphic granite mentioned previously. Near Thompson Island the beds run W. S. W. and E. N. E., but again in a short distance are found slightly twisted or wavy, although preserving a general parallel strike to that first noted.

Hornblende-mica-gneiss at Thompson Island.

"From Priest's Point, the lake gradually narrows from a minimum width of four miles, to a narrow inlet less than a mile wide at the outlet, and the course of this part lies very nearly S. W. and N. E., following in a general way the strike of the rocks. A band of dark mica-schists is crossed, reaching from near Priest's Point to twenty miles S. W., and along the course followed through the islands many small dykes of a quartzose fine-grained granite were found, in which iron pyrites is freely developed. The beds of fine-grained gneiss on Camping Island ten miles south from Priest's Point, are also found with many veins of pyrites and on the hill in the centre of the island many of the beds are very much rusted and decomposed. The pyrites is found to contain a small percentage of nickel and traces of cobalt. At the north side of a small creek on the west shore, south-west from Camping Island, the Indians report a soft soapstone or serpentinous rock from which they make pipes, but a visit to the locality did not result in finding this rock, which was then said to be obtained in small pieces from the shore and generally under the water. The rock there, was

Band of dark mica-schist.

Pyrites in gneiss on Camping Island.

however, a light green sericite-schist, and it is possible that unfoliated or less cleavable portions of this might be soft enough for the purpose named. The stratigraphical relations of this band with the surrounding gneisses, could not in the time at the disposal of the party be made out, so that it is problematical whether this may be a small area of highly altered Huronian beds or not. The next rock occurring to the south is a dark garnetiferous gneiss, followed by reddish granitic gneiss to the outlet of the lake." Sericite-schist.

Reindeer River.

"Reindeer River drains Reindeer Lake into Churchill River, and forms one of the largest branches of that river. The lakes to the north are all of clear water, and Reindeer River is remarkable in being beautifully clear and cold, forming thus a contrast to the dark water of the Churchill above the junction of the two streams. The valley through which it runs is an irregular depression following roughly the trend of the gneiss. From the south end of Reindeer Lake, two outlets exist by which the waters flow with slight current to a round lake-expansion to the south. Thence, falling out by the east side around a rocky island, it passes in succession through two lake-expansions with rapids and falls separating them, before it assumes the dimensions of a river and turns to the south. The first fall on leaving the lake is ten feet in height, over ledges of gneiss. The portage past this is across a narrow rocky islet fifty yards wide, and is known locally as the Rock Portage. The second, which is between the next two lakes, is called the White-sand Portage, so named from the cliffs of sand on the north side, opposite the portage. The rock exposed on the portage is a dark gneiss running S. 15° W. or N. 15° E., and standing vertical. The river in this course runs to the eastwards about five miles, and from there to the Churchill bears due south, though the main part lies to the eastward of this line. The dark hornblende-gneiss found at the White-sand Portage, and on the lake to the east, is cut in a few places by a whitish intrusive granite. Valley of Reindeer River. Rock and White-sand portages.

"The river narrows after turning to the south and flows through a low swampy flat confined between high ridges. Before entering the swampy stretch, there is a sharp bend at which the river falls slightly over ledges of dark gneiss, and the many eddies along the face of the steep banks make it dangerous for small boats. The place bears the name of the Devil's Rapids, and expresses the Indian's fear of this as a treacherous place. Devil's Rapids.

"In this swampy tract, the banks are mostly a mossy swamp and the current is not strong, but very regular. Turning slightly to the east, a wide lake-expansion is crossed. High hills surround this, and a narrow passage of a quarter of a mile connects with another called Red-hill Lake. A branch of the river is said to leave the lake above Devil's Rapid, and by a detour to the east to again join the main stream at Red-hill Lake. On Mr. Cochrane's survey, this branch is called the Stump River. To the east of the mouth of this river, a prominent hill with red colouring along the ridge, forms a very marked feature. On a nearer view, this red colouring is found to be due to the débris of a decomposed band occupying the crest of the ridge. The rock has been very highly charged with iron oxides and pyrites. The strike of the beds is S. 10° E., with dip eastward at angles varying from 60° to 80°. Several large seams of red granite cut into the hill and break up the beds somewhat.

Red Hill Lake and Stump River.

"A section of the hill shows a light, coarse gneiss near the bottom, with a dark mica-schist, followed by a bed of light rusty coloured gneiss having a thickness of about five feet. This in some places seems to have been very rich in pyrites and is weathered out to a reddish ochre. The outcrop is just below the crest of the ridge, and from it the ochre falling down, stains the whole face of the hill. Above, on the summit the rock is mostly a dark-red gneiss.

Red Hill.

Ochre.

"The river between Red-hill Lake and Steep Hill Portage, runs directly south, passing through several small lake-like expansions, on which the rocks are found to be generally gneiss, dipping to the north-east, but cut into by large dykes of red granite. Large bosses of this same intrusive material are seen at the middle distance or just north of the mouth of White River. Above the Steep Hill Portage, the river broadens out to a lake about two miles in diameter. Into the north-western corner a branch of the Reindeer River enters from the west. This stream, the White River, drains White Lake, into which two branches fall—one from Whitefish Lake and the other said by the Indians to be a small channel draining from the Churchill River above Stanley Mission. The usual route from Stanley to Reindeer Lake is by this stream and the White River. Another route, said to be feasible for large York boats, is from Reindeer Lake up the Vermilion River, which enters on the western shore, to Vermilion Lake, thence up still farther to a second lake and southward to the Churchill by a stream said to be large and of easy fall to the English River near Stanley.

Intrusive granites.

White River route to Churchill River.

"At the Steep Hill Portage, light clay is seen in greater quantities than farther north. A ridge of clay thirty-five feet high is crossed

Steep Hill Portage.

in making the portage. The lake above drains to the east and falls over a steep ledge, between three islands, at the south-east corner, making about twenty feet fall. The boats have to be portaged here as well as the goods. The sides of the valley are more thickly timbered with poplar, and a few small trees of white spruce were noticed a few miles below the Steep Hill Portage. The river makes a long bend to the east and then south, passing through a wide lake-like expansion with many islands, narrowing at places, in which the current is found quite strong, but generally, from the Steep Hill Rapids to near the mouth of the river at the Deer Rapids, the river is wide with little current. From its eastward bend it turns to S.S.W. and maintains a very uniform course to its mouth, following a valley which is parallel to the strike of the gneiss. The sides of the valley are clothed with small poplar, showing patches of the darker foliage of the spruce. Veins of a reddish pegmatite are occasionally seen cutting the gneiss, and larger masses occur on the east shore above Deer Rapid. The last interruption to the navigation of the stream is at Deer Rapid, about two miles north from Churchill River, where there is a fall of about five feet over a ledge of gneiss. Below this is a wide deep channel, in which the current is almost imperceptible. The junction of these two streams may be said to occur in a narrow moon-shaped lake, occupying a depression in the valley common to both streams. The Reindeer River enters at the north end and the Churchill at the south-west; while the outlet is from the east side by a narrow gap, through which the river pours in a wild rapid. Below this the Indians report the remains of a trading post, which is probably the site of old Fairford House.

Deer Rapids.

"The water of the Churchill is found to be very much darker in colour than that from the north, and evidently contains much more organic matter, as the shores show a greater profusion of aquatic plants and the submerged surfaces of rocks bear an abundant growth of sponges and the smaller forms of algæ. On the Reindeer River and the lakes above, all the submerged rocks appear bare and clear.

Character of water of Reindeer River and Churchill River.

A chemical examination of the waters from Reindeer Lake and Churchill River was made by Dr. F. D. Adams in the Laboratory of the Survey in 1882.* In summing up the general results, Dr. Adams says:—"Of the foregoing waters that from Reindeer Lake is remarkable for the small amount of dissolved solid matter which it contains; in this regard it would take rank with the waters of Bala

*Report of Progress, Geol. Surv. Can., 1880-82, p. 6 H.

Lake, Merionethshire, Wales, and Loch Katrine, Perthshire, Scotland * * *."

Churchill River.

"The first fall on the Churchill River above the mouth of Reindeer River, is a steep descent of fifteen feet over dark greenish schists, forming what is called the Kettle Fall. A portage of 130 yards is made on the north side over a ledge of these schists.

"Up to Conjuring Creek, the course is obliquely across the strike of the gneisses, and those crossed are of the following varieties.—A dark gneiss, forming a wide band, follows the valley of the Reindeer River and is exposed on the Churchill up to near the Kettle Fall, where we cross dark green hornblende-schists, forming a band nearly a mile wide running to the south. A granitic gneiss occupies most of the lake above Kettle Fall, but at the western extremity a dark band of fine-grained hornblendic gneiss, in many places a black schist, is found to occupy the bottom of a valley, which here reaches the lake coming from the south and south-west, and in which the upper extension of the Churchill River runs. This dark band appears to have been more easily denuded than the granitic rocks apparently flanking it on both sides, so that to near the Trade Portage it occupies the islands in the channel and strips and points along the shores. The Trade Portage rocks are of the lighter granites and gneisses which lie along the eastern border of the dark band. The strike of these gneisses above the Trade Portage, bends more to the west and the dark band is seen at intervals to Key Rapid, the second above, where a long island divides the channel into two parts. The rocks dip here N. N. E. $< 30°$. They are mica and garnet schists and cleave into thin laminæ.

Band of dark schist in centre of valley near Trade Portage.

Trade Portage gneisses.

"Above, is a long lake-expansion in which are many large islands forming a continuous string with small openings between, to the end of the lake. The north side and parts of the islands are of the dark schists running about west. The upper part of the river now leaves the dark rocks, which are deflected to the north, and on the next lake above are found a series of gneisses and greenish schists running more in a northerly direction, giving place on the west to lighter gneisses, broken by many granite veins and dykes. Forks Lake, into which the outlet of Lac la Ronge empties, is of larger dimensions than those immediately below, and on it the rocks are found trending to the north and north-east. A light-coloured gneiss is found to contain a wide band of crystalline limestone, the first seen in the Laurentian in this district. At the end of the lake several of the small islands are of red granite, in which patches of the gneiss occur as inclusions, and large bosses and veins of the same granite are seen at several places along the south shore to near Stanley Mission.

Gneisses of Churchill River above Trade Portage.

Crystalline limestone on Forks Lake.

"The rocks are everywhere glaciated and more or less polished. On the granitic rocks the striae are very obscure, but on the finer grained gneisses and schists are better marked. At the Trade Lake, above Trade Portage, the direction is S. 40° W., and half way to Stanley they are about S. 32° W. Glacial striæ on Churchill River.

"The gneisses of the lower part of Churchill River are seen to follow roughly the course of the valley, without any great local disturbance, merely a general bending to follow the long curve. But nearing Stanley Mission the change in strike is seen to carry the prominent dark band by a rather sharper curve to the north, and the succeeding beds on the west become broken into by a light granite, past which the gneisses are found to be running to the east of north. Change in strike of gneisses near Stanley Mission.

"From Stanley Mission to Lac la Ronge the course is to the west of south, and the gneissic bands exposed on the bay into which the canoe-route leads are apparently the same as at the Mission, while the same band is followed through the chain of islands which extend to the mouth of the Big Stone River. The general direction in which this is found to run is about W.S.W. Band of spotted gneiss.

"These gneisses are porphyritic in several places, being spotted with large phenocrysts of plagioclase, surrounded by a darker—almost black—matrix. Under the microscope a decided cataclastic structure is apparent. Farther south, the squeezing has developed a ropy or beaded structure—the coarser crystalline granitic material being arranged in a series of lenticular and oval patches between the layers of finer gneissic and schistose rock that is much darker in colour. The contrast in colour brings out the structure very plainly as will be seen by the accompanying plate. The photograph was taken at the south end of a long point or island on the west shore of Lac la Ronge, about five miles north of the mouth of Big Stone River. Beaded gneiss.

"The succeeding beds to the westward were seen only on the canoe-route near Stanley. They appear to be of a fine-grained greenish gneiss, approaching a schist, forming with the spotted gneiss of the lake, a narrow band of less than a mile wide, followed to the west by reddish coarse-grained gneiss.

"A covering of drift conceals the underlying rock of the vicinity of the south-west corner of Lac la Ronge and extends southward, being apparently covered in turn by a thick deposit of stratified sand, forming a plateau extending north from Montreal Mountain to within eight or ten miles of the above lake. In this area the only indication of the nature of the rocks below is to be derived from the boulders, Drift deposits south of Lac la Ronge.

and is of course very uncertain. At the trading post between Egg Lake and Big Stone Lake, several fragments of a light-yellow dolomite or limestone were noticed, and would seem to indicate the presence of rocks of this kind in the vicinity or to the northward. The Indians reported exposures of a similar rock on the south shore of Lac la Ronge, so that the extension of the limestones of Lake Winnipegosis or of Pine Island Lake may be expected as far north as Lac la Ronge.

Montreal Lake.

"Montreal Lake is a shallow basin about thirty miles long and from five to ten miles wide, lying to the north of Montreal Mountain and on the sandy plateau above mentioned. The outlet is by a small stream flowing northwards. This cuts gradually through the terrace, and near the northern edge shows a section of sixty feet of stratified sand. To the north of the sandy terrace, the stream turns to the east and passing through several small lakes in the drift-covered region, reaches the south-west corner of Lac la Ronge.

Terrace of stratified sand.

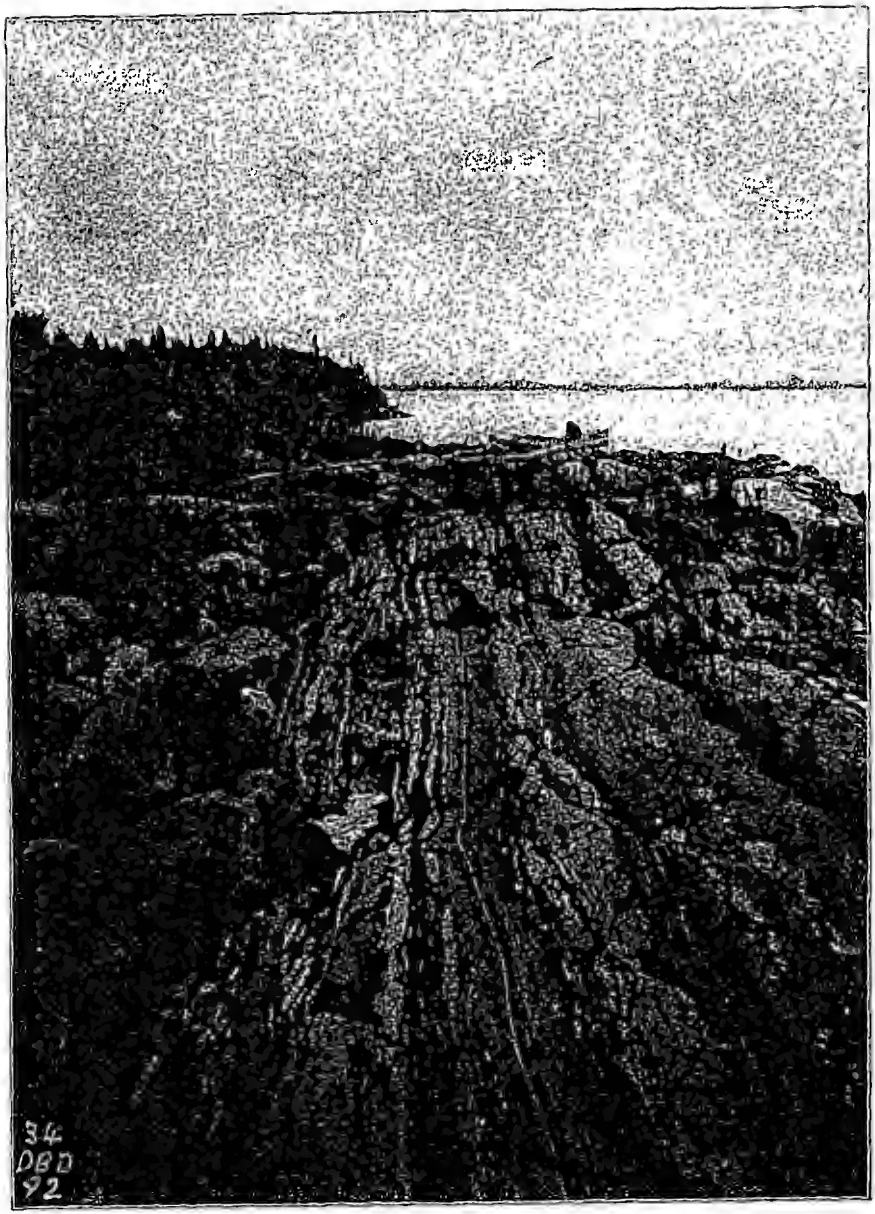
"The timber in the rocky country bordered by the southern shore of Lac la Ronge is not large or abundant. Southward there is some improvement, and large individual spruce trees occur occasionally. The 'lob sticks' at Big Stone, Hudson Bay Company's post, are fine examples of these. On the Montreal River, small Banksian pine cover the eastern slope of the sandy plateau. No large timber, spruce or pine, is seen till near the lake, where at the southern end some groves of large spruce occur. On the watershed south of Montreal and Deer Lakes the largest timber is seen. Here the formation of the country is evidently morainic, but southward the country slopes gently toward the Saskatchewan River."

Timber of country near Montreal Lake.

Geikie River.

Geikie River opens with a bell-shaped mouth into the bottom of Nekweaza Bay of Wollaston Lake. The water is clear, but of a slightly brownish tinge. At the first narrows, in which there is no perceptible current, are high hills of dark-gray well-foliated biotite-gneiss, striking N. 60° E., and with vertical dip. Above this is another stretch of quiet water studded with high elongated or dome-shaped rocky islands, while similar hills also rise on the shore. One arm of this lakelet runs off S. 60° W. on the strike of the gneiss, but the smoke that filled the air, caused by forest fire started by the Indians, prevented us from seeing how far. On the eastern shore one high point was found to consist of coarse red granite. The eastern arm of the lakelet was followed through a strait into another lake-like expansion, the shores

Narrows.



D. B. Dowling.—Photo., Sept. 27, 1892.

BEADED GNEISS

South-western shore of Lac la Ronge.

of which are at first high rocky ridges of gneiss, and then become lower and thickly strewn with boulders. The underlying rock here does not come to the edge of the water, though it may occasionally be seen in the distance, and is then apparently micaceous gneiss, the same as that recorded above.

Plain of white sand.

On the evening of August 25th camp was pitched on the west bank in latitude 57° 38′ 30″, on lightly rolling white sand, wooded with small Banksian pines.

River deep and without current.

Three-quarters of a mile above this camp, the dark-gray gneiss crops out at a rounded point on the east bank, striking N. 70° E. and dipping S. 20° E., at an angle of 55°. It is cut by, and interlaminated with bands of red pegmatite. For three miles and a-half further, to the foot of a rapid, the river is deep and a hundred yards wide at its narrowest parts, with a scarcely perceptible current. In some places high sand-hills rise on the west bank, and occasionally low outcrops of gneiss were also seen. The rapid here reached has a fall of about three feet over a ledge of gneiss. An island lies in the middle of the current, on the east side of which the canoe was tracked up with a line. The river here carries about as much water as Stone River, below the mouth of Waterfound River.

Long Rapid.

Two miles further up stream, there is a heavy long rapid, in which the channel is wide and full of boulders. The cargo was landed on a sandy slope on the west bank at the foot of this rapid, in latitude 57° 35′ 45″, and two of the men continued up the stream with the empty canoe.

Portage.

The cargo was carried for 1800 yards across a portage, first up a gently rising sandy plain, sprinkled with boulders, then into a valley and across a deep bog, 115 yards wide, then over low sandy hills and down forty feet into a valley, to the reedy shore of an arm of the river. There is no sign of the underlying rock on the portage. The total rise as shown by the aneroid, was forty-five feet.

Straight valley.

This closed arm of the river was followed south-westward in a straight valley, between steep sandy banks fifty feet high, for a mile and a-half, until the river was again reached, flowing in a continuation of the same valley, out of the side of which it cuts between two rounded sand-hills, to rush down the rapids below. Above this arm it flows between sand and gravel banks to the mouth of Poor-fish River, a stream, navigable for canoes, flowing from the southwest.

Poor-fish River.

Above Poor-fish River, Geikie River widens to a small lake, the shores of which are generally wooded with spruce, through which rise some high hills of sand and boulders. Near the south end of the lake

is a small island of coarse, red massive biotite-granite, cut by quartz veins, and scored by glacial markings, trending S. 30° W.

Rapid. Two miles and a-half further up the currentless river, between wooded hills, there is a heavy rapid over a bed of boulders, with a total fall of about thirty-five feet. The men hauled the canoe up this rapid, but an easy portage 600 yards long can be made over a sandy plain on the east bank.

Three-quarters of a mile above the rapid, up the river, now wide and with swampy banks, camp was pitched beside a little knoll of gray, slightly reddish, very compact biotite-gneiss striking N. 60° E., and dipping S. 30°, E. 35°.

Rapid. For the next two miles the river is generally rapid, running over a bed of boulders, and has a total fall of about thirty-five feet. Low outcrops of gneiss were occasionally seen. Above these rapids, for fourteen miles, the river is straight and wide, like a long narrow lake, with current at a couple of places near the middle of the distance. The shore is composed of sand-hills and wooded sandy banks, with occasional Hill of gneiss. banks of peat. A few hills of gneiss also approach the river. One of these, six miles from the north end of this straight reach, is a high rounded hill of an indistinctly foliated dark-gray biotite-gneiss. The summit is well smoothed and shows many distinct parallel glacial grooves trending west. As they differ so greatly in direction from all the other glacial markings found on the river, they are supposed to have been formed by a local glacier, after the retreat of the Keewatin glacier.

Above the quiet water of the lake the canoe was hauled up two rapids, a quarter of a mile apart, between hills of boulders, then paddled for half a mile along a wide shallow piece of river to the foot White Spruce Rapid. of White Spruce Rapid, a swift narrow rapid with a fall of about eighteen feet. The canoe was landed on the east bank and carried on a portage 1100 yards long beside the river, over a stony hill, and along a stony hillside through small black spruce woods. The rapid is a very picturesque one, the water tumbling over a series of rocky barriers of gneiss, and then over and between large rounded boulders. In places the west bank is low and sandy, and wooded with some fine large white spruce, the first observed on the river. Under the trees pembina berries, raspberries, &c, were growing in profusion. Camp was pitched at the head of the portage on a slope covered with reindeer moss, and a short distance back from the marshy border of the river.

The next morning we continued for three miles up the straight quiet river, between sand ridges, to a fall over a ledge of massive rather fine-grained red granite, past which the canoes were carried on the west bank for 180 yards over a stony hill, through small Banksian pines. Sand ridges.

For the next three miles, the river is for the most part shallow and rapid, flowing between hills and ridges composed of fine reddish sand or silt, mixed with rounded waterworn cobbles and boulders. The sandy material here, as well as that along the banks all the way to the mouth of the river, is much finer and more silty than that seen on Stone and Cree rivers, and supports a much stronger growth of vegetation.

At this point the country changes. The hills are no longer composed of sand, but consist of gneiss or boulders imbedded in silt and white sand. These boulders are almost entirely of granite or gneiss, and but one small one of Athabasca sandstone was found. Glacial striæ run S. 20° W. Change in character of country.

A moose was here shot and the following night was spent drying the meat, so that we might be able to carry it more readily with us. In the morning the dried meat was put in one flour sack. Moose.

Above camp we tracked and poled up two heavy rapids over boulders, in which the river falls respectively thirty and twelve feet. The river flows in a sloping valley 30 to 40 feet deep cut in a somewhat irregular plain of sand and travelled cobbles and boulders, above which rise occasional rounded hills, probably of gneiss. Above the second rapid a narrow lake four miles long was entered. A gray biotite-gneiss outcrops at points here and there on its shores, striking generally parallel to the course of the river, and cut by many granite veins. At one point on the west side, there is a low exposure of massive red and green granite, composed chiefly of orthoclase and fibrous hornblende, but containing a large quantity of titaniferous iron ore. Above the narrow lake is a fall, with a descent of eight feet, where the river flows between vertical walls of rock, that on the west side a well-foliated biotite-gneiss with vertical dip, and striking along the stream, that on the east side a fine-grained red granite. The canoe was carried for 350 yards on the east side, over the smooth surface of the granite, to a little grassy bay above the fall. Heavy rapids. Narrow lake. Falls.

Above the fall are two rapids, with descents respectively of about five and two feet, to the north end of what is known as Big Sandy

River straight.

Lake. Thus far the river trends remarkably straight in a southerly direction, its course being determined by the strike of the gneiss. The surrounding country is much more heavily covered with drift than most of the Archæan areas further north and east. When exposed the rocks are not polished, and glacial markings are not common.

Rocks unpolished.

Big Sandy Lake.

Big Sandy Lake is fifteen miles long, from a quarter to half a mile wide, and like the river, lies in a north-easterly and south-westerly direction. Generally speaking, it lies along the line of contact of the massive red granite, holding a large quantity of titaniferous iron ore, to the east, and the gray biotite-gneiss to the west. For three days we were detained in camp on its western shore by a heavy cold storm of wind and rain. Camp was pitched in open pine woods on a sandy terrace ten feet above the lake. Behind us rose a gentle sandy slope, scattered with a few boulders, to a rounded hill, a hundred feet high, of granite and gneiss in very irregular contact and in about equal amount. On the fourth day, September 2nd, the remainder of the lake was surveyed in the drizzling rain. On both sides were ridges of rock, or sand and boulders. The country gradually became more barren, until the small, thinly scattered pines appeared to form but an open stubble over the surface.

River above the lake.

The river that was found flowing into the south-west end of the lake, does not bring in more than a third of the water that leaves the lake. It is about fifty feet wide and is spread out thinly over coarse rounded gravel. It comes from the east across the strike of the gneiss for a short distance, and then turns again from the south-west. On both sides are high barren hills covered with boulders. Many of the hills have a core of gneiss. One, which was ascended, was found to be 180 feet high. Its summit is of gray biotite-gneiss striking N. 55° E., and with vertical dip, cut by bands of red granite. Its sides are scattered with boulders. Other hills are composed entirely, as far as could be seen, of water-worn sand and gravel, with a few scattered boulders. No definite regular arrangement of this detrital material could be detected, but it was probably deposited at or near the face of the Keewatin glacier as it gradually retreated towards the north.

Moraine.

Camp was pitched a mile and three-quarters above the lake in north latitude 57° 1′ 15″, in the bottom of a valley fifty feet deep. In front of the tents flowed the shallow rapid stream, now only thirty feet wide.

Deep valley.

For half a mile above this camp the river flows in a sloping valley a hundred feet deep, when it turns from the south-west and flows

through a plain of sand and gravel, above which rise occasional rounded knobs of gray gneiss. Again it turns from the south-west in a very narrow valley, to the north-west of which is a narrow kame composed of sand and gravel. Beyond the south-west end of the kame, on the west bank, is a high cliff of well-foliated compact reddish-gray biotite-gneiss striking N. 60° E., and dipping N. 30° W., at an angle of 70°. A quarter of a mile above this hill a small lake was entered. This lake lies five miles in a direct line from the Big Sandy Lake, and, as has been seen, the whole of the intermediate country is buried under stones, gravel and coarse sand borne from the face of the Keewatin glacier. Kame.

Into the western angle of the lakelet the river issues, and above it, for three miles and a half, it passes through a moderately level sandy country, the boulders and coarser material becoming less frequent up the stream. At the end of the above distance we entered another lake, passing to the east of a narrow sandy esker-like ridge that projects as a long point into the water. This lake, like the others, lies in a south-westerly direction, but its shores are broken and irregular. The course followed through it, from one end to the other, was eleven miles, as measured by a boat-log, and its greatest width is about three-quarters of a mile. Its shores are high, with thickly wooded slopes extending down to the water. The islands are for the most part ridges of sand and gravel, but both they and the surrounding hills, some of which rise to heights of 300 feet or more, are underlain by gneiss. In one place glacial grooves were observed, trending S. 35° W. Camp was pitched on the east shore, on the edge of a swamp, behind a sandy beach, in north latitude 56° 52′ 45″. Behind us was a low hill composed at the top of a well-foliated gray gneiss, striking S. 25° W. and dipping S. 65 E. at an angle of 45°. Its surface is generally strewn with boulders. Esker or kame. Lake. High shores.

The river, where it flows into the south-west angle of the lake, is 35 feet wide and a foot deep, with low sandy hills flanking it on each side. The little stream then winds in a very crooked channel, with strong current, through an extensive marsh. At a point a mile from the lake, a hill rises on the east bank to a height of a hundred feet above the marsh. Near the base it is sandy, while at the top it consists of a well foliated biotite-gneiss, striking south and dipping east at an angle of 60°. Its rounded surface is rather roughly weathered, but shows distinct glacial grooves, running S. 35° W. To the west is a wide sandy valley, wooded with Banksian pines, stretching out north-westward into low land as far as the eye can see. In other directions the whole surrounding country is sandy, with a few isolated hills. Low sandy hills.

Beaver-dam.

South-west of the marsh the stream spreads out into little elongated ponds, often not more than a hundred yards in width. At one place it was blocked by a beaver-dam, over which we were obliged to carry the canoe.

Forks.

Camp was again pitched in latitude 56° 46′, on a sandy plain wooded with Banksian pine at the junction of two forks of the little river, both of which were blocked by beaver-dams. The surrounding country is undulating and sandy, but to the west is a high hill, the north side of the summit of which is composed of gneiss, while the south side extends into a long ridge of rounded boulders.

West branch.

Gray biotite-gneiss.

We struggled up the west branch of the little river, which here varies from six to twenty feet in width and flows through wooded sandy country, to another small oval lake three miles long and three-quarters of a mile in greatest width. Both its east and west shores are formed of ridges, apparently of gneiss, from 100 to 300 feet high, and its islands are also rounded bosses of the same rock. Many of the higher points are smoothed and polished, showing glacial striæ trending S. 55° W. At one point the rock is a light-gray almost massive biotite-gneiss, the surface of which is beautifully polished and shows two sets of glacial striæ, often separated by sharp angles, the older one trending S. 33° W., and the later S. 20° W. In some places the shore is composed of a wall of boulders. The water in the lake is beautifully clear.

Sand plain.

The stream flowing into the south end of the lake is from six to twelve feet wide, and winds in the bottom of a shallow valley through a plain of sand and gravel. After a course of a mile it comes from another small lake three-quarters of a mile long with wooded rocky shores. Half a mile farther up the creek from this lake, is another small shallow lake surrounded by high spruce-covered hills, and almost divided by a narrow wooded island, apparently composed of sand and boulders. A little rapid streamlet was ascended for half a mile from this lake to another shallow straggling lake, on the south shore of which camp was pitched on the evening of September 5th, on a sandy plain with a thick growth of small Banksian pine, in north latitude 56° 37′ 35″. Around us the country was low, but to the south rose a high unbroken ridge of spruce-covered hills, barring further progress in that direction.

Source of Geikie River.

We had now reached the source of Geikie River, or at least of the branch of it that we had lately been ascending, and it was necessary to find some practicable route by which the canoe could be taken across the height of land to the head of some stream flowing south-

ward towards Churchill River. The first thing to be done was to examine the shore foot by foot, in order to discover whether Indians hunting in this vicinity had ever entered or left this lake by any other route than the one by which we had entered it. At the east end of the lake we crossed a narrow wooded sandy neck of land beside a brook, and entered another little lake a quarter of a mile in diameter, on the east side of which, after long and careful search, we were delighted to find traces of an old portage route, though it was now blocked and barred by underbrush and much fallen timber. The path was 650 yards long, and when chopped out was a very good one, over hard sandy ground through a thick growth of small spruce and Banksian pine. The east end of this portage opens on a narrow, irregular lake, from the opposite side of which a little brook flows across a stretch of low land into another small lake, beside which are high rocky hills. There was no sign of Indians having ever travelled down this brook, so we turned southward to the south end of the lake. The rocky points on its shore are rounded, and consist of red biotite-gneiss, striking S. 30° W., and dipping S. 60° E. at an angle of 50°, but blackened by a thin coating of *tripe de roches*. Finding no signs of a portage, we again turned northward and searched the shores for two miles, to the north end of the lake; where a brook three feet wide was found flowing into it. On each side were high narrow elongated hills or eskers of sand and boulders, trending S. 45° W. Carrying our canoe past this brook for eighty yards, we entered another small lake lying in the same direction as the last.

Old portage-route.

Red biotite-gneiss.

Passing up this lake, to the west of which rise high wooded hills, for half a mile, we found a portage on the east bank at the foot of a steep slope of sand and cobbles. The portage is 325 yards long, the first 225 yards being up a slope of sand and rounded cobbles, over a ridge of gneiss forty-five feet above the lake, and the last 100 yards across a sand-plain to the end of a lake lying transversely to the last. This lake is narrow and three-quarters of a mile long, with low wooded shores. From its east end a brook flows eastward, on whose north bank we carried the canoe for eighty yards to another and rather larger lake, across which we travelled for a mile and a-half to its outlet in a brook six feet wide, near which we camped for the night in north latitude 56° 38′ 18″. The variation of the compass was found to be 25° east.

Height-of-land Portage.

The work of the next few days showed us that the low sandy country which we had just crossed lies on the height of land between the waters flowing to Wollaston Lake and those flowing to Churchill

Low sandy country.

River. As we have seen, the country to the north of this watershed is thickly covered with detrital material, brought by the great Keewatin glacier and its glacial streams and lodged near its front as it retired to the north.

Foster Lake and River.

Brook flowing southward.

From camp we descended a little brook, that tumbled over boulders in a wooded valley, for a quarter of a mile, to a fall over a ridge of green and red hornblende-gneiss containing a considerable quantity of titaniferous iron ore in small grains. The canoe was carried for 190 yards on the south-east bank to the foot of the rapid.

Small lake.

The brook enters the south-western extremity of a larger lake of very yellow muddy water, with rather low shores fringed with boulders, but with occasional points composed of gneiss striking in the direction of the long axis of the lake. One smoothly polished surface showed glacial striæ, trending S. 48° W. The lake is five miles and a-half long, and its south-east shore was followed to its north-eastern end, where a short rapid stream was found flowing eastward into another lake, which was not recognised at the time, but which we afterwards learned to be an arm of Foster Lake, so called in honour of Hon. G. E. Foster, Finance Minister of Canada.

Foster Lake.

Three-quarters of a mile south-east of the mouth of the brook, is a high island of gray hornblende-gneiss, striking S. 20° W., and with a high dip to E. S. E. From the top of this island the lake is seen to extend a long distance north-eastward with a high esker-like ridge on its north-west shore, and on the south-east shore some cliffs of sand. Generally speaking, however, the surrounding country is rather low, undulating and thickly wooded.

At the time it seemed to us that this might be a lake lying on the Vermilion River which flows into the south-west side of Reindeer Lake.

Again turning southward, for we were anxious to find a passable canoe-route in that direction, we paddled for two miles to the mouth of a little brook two feet wide flowing into the bottom of the lake. Here we had the good fortune to find a portage newly cut out by Indians apparently travelling southward to Ile à la Crosse, and we at once decided, if possible, to follow them.

Recent tracks of Indians.

The portage was 250 yards long, over a flat composed of broken fragments of gneiss. It leads to the north shore of another lake four

miles long with thickly wooded rocky hills on both sides, though the beach is often composed of boulders.

Behind a small island at the south end of this lake, the fresh Indian trail was again found on a portage 225 yards long. The first half of this portage was up a sandy slope wooded with small Banksian pine to the top of a hill of gray, not very evenly foliated gneiss, striking S. 30° W., while the second half was down a very gentle slope to the swampy shore of a small lake thirty-five feet above the last. Camp was pitched on this portage, in latitude 56° 36′ 30″.

Small lakes and portages.

The next lake was only a quarter of a mile wide, beyond which was a portage eighty yards long, over a flat composed of broken fragments of gneiss, to another lake three-quarters of a mile long, discharged by a little brook eighteen inches wide; but the Indians had not passed here, so we searched back around the eastern shore till we came to the portage. It was 950 yards long, and led south of a high rocky hill over rolling country of sand and boulders to a small lake from which is a portage 200 yards long, over a sandy ridge, to a sloping sandy beach at the bottom of a bay of what was afterwards found to be the lake known to the Indians as Little Whitefish Lake.

Little Whitefish Lake.

The wind had now risen very high and it began to rain, so that our progress was much impeded. The lake is a very pretty body of clear, cold water. Its contour is very irregular, and it is divided into two roughly equal parts by a strait 725 feet wide. Its shores are rugged and rocky, rising into high thinly wooded hills and ridges, separated by deep valleys. The rock is an evenly foliated reddish-gray granular biotite-gneiss, with a general strike S. 25° W., and a high dip, cut by many large and small veins of red pegmatite. There is but little sand or till, and the rock is almost everywhere well glaciated, showing glacial markings trending S. 30° W. The lake is discharged by a stream fifty feet wide, with stiff current, flowing between low rugged points of gneiss. A third of a mile lower this stream flows over two little rapids into another irregular lake similar to, but smaller than, Little Whitefish Lake. On a low rocky point on its shore we camped, in pouring rain, on the evening of the eighth of September.

Circling to the right round the rocky shores of this lake, we travelled seven miles in search of its outlet, which we at length found less than a mile from where we entered it. The rapid at the head of the river was run with the half-loaded canoe, and a short distance below it another winding lake was entered. At its entrance is a point of coarse dark-gray hornblende-granite-gneiss, cut by many joints and breaking down in vertical cliffs.

We passed for three miles and a quarter under the rocky banks and islands of this crooked lake, and down the river for a mile and three-quarters over two little rapids, to its mouth in a lake which was subsequently found to be Foster Lake, and which the Indians at Ile à la Crosse afterwards told us, was the same lake we had left two days before. We paddled for three-quarters of a mile, to a high point of heavily laminated gneiss striking S. 45° W., and with almost vertical dip. From this point we passed out into the large lake, studded with islands, when Heddery, one of our Chippewyan Indians, suddenly recognized a point where he had taken dinner in the previous spring. He at once recalled to mind the geography of the surrounding country, and as he had many times descended the river flowing from this lake to Churchill River, all uncertainty as to our course was at an end. We were on the regular hunting grounds of the Ile à la Crosse Indians, and the remainder of our course to that trading post was known to both our Chippewyans.

Foster Lake.

We immediately turned into a bay, rather more than half a mile deep and reached a river of considerable size at a heavy rapid. This rapid has a descent of ten feet, the upper part in a gorge between rocks only ten feet apart, and the lower part wide and over a bed of large boulders. The canoe was carried for 270 yards on the north bank to a grassy flat at the bottom of the rapid. A hundred yards below, the river opens into the side of a long narrow lake, stretching north-east and south-west, belonging to the group of lakes here called Foster Lakes. We turned southward for a mile and a-quarter and camped on its west shore, behind a little sandy beach at the foot of a steep cliff of gneiss, striking south-west and dipping north-west, at an angle of 60°. The country passed through during the day rises in high rocky hills, sand-plains and hills of boulders being conspicuously absent.

Heavy rapid.

High rocky hills.

The country now slopes southward, and the detrital material derived from the drainage of the Keewatin glacier appears, for the most part, to have been carried away by the rapid streams, instead of lodging near the foot of the glacier, as it had done north of the watershed.

Foster Lakes are said to consist of three long irregular bodies of water, connected by short stretches of rapid river, and like Wollaston Lake, to discharge by two outlets in opposite directions, the Vermilion River flowing north-eastward to Reindeer Lake, and Foster River flowing southward to Churchill River. But the lateness of the season, and the almost exhausted state of our provisions, prevented us from exploring the lake in any other direction than towards the head of Foster

Foster Lakes.

River. This arm of the lake, from the mouth of the river just descended to the head of Foster River, is fifteen miles long and about half a mile wide, but narrowing at one place to 150 feet wide. The shores are composed of high ridges of rather dark fine-grained biotite-gneiss, striking south-westward, their sides descending in wooded slopes to a beach of boulders. At the Sandy Narrows, four miles north-east from the head of the river, there is a stiff current between high thickly wooded hills. Just at the foot of the current, on the west shore, is a long narrow esker-like ridge of sand and boulders, running S. 30° W., wooded with a pleasant grove of aspens, giving promise of more fertile country further south, where, as the Indians said with glee, we would burn only poplar. To the south-west of the sandy ridge is a hill 175 feet high, composed of dark highly garnetiferous biotite-gneiss, interlaminated with many bands of very coarse white pegmatite. For the rest of the way to the head of the river the shores consist of similar garnetiferous gneiss. Esker.

From the lake, Foster River continues to flow in a deep valley along the strike of the gneiss, and for eighteen miles, measured in a straight line, it is one almost continuous series of heavy rapids over a bed of well-rounded boulders. Most of these rapids were descended with poles. The river seldom impinges against the rocky banks, but where seen the rock is a dark gray biotite-gneiss or schist. Towards the end of the distance mentioned, the rapids are separated by wide shallow stretches of quieter water, and hills of sand and boulders begin to make their appearance. At the end of the eighteen miles is a heavy crooked rapid with a descent of ten feet, past which the canoe was carried on the west bank for 280 yards, on a sandy slope at the foot of a hill of sand and boulders, and then over a flat of large boulders. Foster River.

Half a mile further south, the river touches the foot of a hill of rather coarse-grained reddish biotite-granite-gneiss, striking S. 60° W. and dipping N. 30° W. at an angle of 40°. It is interlaminated here and there with occasional distinct dark bands of gneiss or mica-schist, with a large proportion of biotite. Hill of reddish gneiss.

On entering this country of red gneiss, the valley spreads out into sloping basin-shaped depressions. At first, for five miles and a-half, the river takes a very straight course between wooded hills, having a moderate current, except at three heavy rapids where rocky barriers cross the stream. At these rapids portages were made on the east bank, respectively 275, 200 and 210 yards in length. Afterwards the river winds for three miles and a-half, measured as the crow flies, in a very Valley expands.

crooked channel with reedy banks, through a low marsh, occupying the bottom of a basin surrounded by rocky hills.

Below this marsh it drops in a very beautiful fall, where a barrier of reddish gneiss crosses its course. The canoe was carried for 160 yards on the east bank, over rock and through swamp, to the foot of the fall. About 300 yards below the foot of this portage the canoe was again put ashore on the west bank and carried for 750 yards over gently undulating sandy ground and over a bench of sand and rounded cobbles, to the foot of a long rapid in which are two abrupt falls over bands of similar gneiss.

Little Whitefish River.

For half a mile farther, the river continues to flow in the same southerly direction, until it is joined by Little Whitefish River, a stream of considerable size flowing from the west.

Change in course of stream.

Thus far Foster River had been a rapid torrential stream, flowing in a very direct course southward in a well-defined channel and not expanding into lakes. Here it turns sharply eastward and at a distance of a third of a mile, reaches the head of another rapid, past which the canoe was carried for 275 yards, on the south bank, over a little hill, the centre of which is of reddish gneiss, while the sides are of sand and rounded cobbles. A short distance below this hill a rounded boss of dark-gray gneiss shows distinct glacial grooves, trending S. 32° W. Three-quarters of a mile lower down the stream the water rushes over ledges of reddish gneiss, with a descent of eight feet, down which the empty canoe was run. The load was carried for 250 yards on the south bank along a sloping rounded hillside over broken fragments of slippery rock.

Sand plain.

The country now changes considerably, the rocky hills almost entirely disappear, and the river flows in a narrow crooked valley through a sand and gravel plain or terrace that rises forty feet above it. This plain gradually descends until, in latitude 55° 58′ 45″ it was found to be but three feet above the water. The river, 150 feet wide, here runs with an easy current in a channel overhung with willows.

One of the men was observed writing in syllabic characters on one of the trees, and on being asked what he had written he answered, "Namukakwé mechim" (no food at all). For the remainder of our journey to Ile à la Crosse we depended on ducks shot by the way.

Bold rocky shores.

Below this place, the sandy plain descends to the level of the river, which flows through a low marshy tract, until passing through a bed of reeds, it enters a lake with bold rocky shores. Three-quarter-

of a mile above the lake, the river impinges against the foot of a high ridge, running S. 15° W., of a medium-grained red granite, in places slightly foliated, and interlaminated with occasional bands of medium-grained dark-gray mica-diorite-gneiss. In the lee of the rocky hill boulders are scattered, imbedded in a fine white sandy clay or rock-flour. The lake is three miles and a-half long, the shore to the south-east being almost bare red granite, while the rocky hills to the north-west are generally covered with forest. Below the lake the river rushes down two rapids hardly a quarter of a mile apart, both over reddish gneiss. Past the first, the canoe was carried for 300 yards on the north bank, over stony land covered with scrub; and past the second it was carried for 500 yards on the south side over a ridge of gneiss, with low country on both sides.

Sandy Creek.

A mile and a quarter below the latter portage, past a narrow winding lake, Sandy Creek, a stream between twenty and thirty feet wide, flows in from the north; and three-quarters of a mile farther, below three short rocky rapids, is a portage eighty yards long on the south bank. On this portage, among woods of small white birch and stinking willow *(Viburnum lentago)* camp was pitched on the evening of the 12th of September in latitude 56° 3′ 35″.

River turns southward.

Below this camp the river continues to flow between rocky banks north-eastward for a mile and a-half, and then turns sharply southward to a heavy rapid where the water flows over red and dark-gray gneiss, striking S. 40° W. Here the canoe was carried for 380 yards on the west bank, along the foot of a hill of gneiss, over a soil of fine light-gray silt, made up chiefly of small angular grains of clear quartz. This fine sand lies in all the little depressions in the rock surface. Three-quarters of a mile lower is another short swift rapid, with a descent of five feet over reddish gneiss, past which the canoes were carried for 140 yards on the east bank, over gneiss and the soft gray silt.

The river continues to flow southward with a decreasing current for three miles, until it empties into a narrow lake, three miles long, on each side of which are high gneissic hills, thickly wooded with small poplar and spruce.

High gneissic hills.

Below the last lake, the river is again well-defined for two miles. In the middle of the distance it passes through a deep narrow valley, with thickly wooded slopes on each side, to a rapid over boulders with a descent of about fifteen feet. This rapid is passed by a portage on the west side 600 yards long, through thick woods over a narrow morainic

hill, composed of boulders imbedded in the light gray silt. On the bank, at the foot of the portage, is a little gravel terrace. No rock in place is exposed in the vicinity.

Jumping-into-the-water Lake.

The river then opens into the northern arm of Jumping-into-the-water Lake. This lake is nine miles in length, gradually narrowing towards both ends, and bellying out towards the east, in the middle. Its northern end has rather low easily sloping shores, with some sandy beaches, while its southern shores are very rugged, steep barren rocky hills rising from the edge of the water. A point on a wooded island near its centre was found to be composed of highly garnetiferous biotite-gneiss striking S. 45° W., and dipping S. 45° E., at an angle of 73°. The rounded surface of this gneiss is much decomposed, but shows strong glacial grooves trending S. 40° W. Camp was pitched on the evening of September 13th near the south end of the lake, among small poplars, at the foot of a rocky hill of reddish-gray gneiss rather unevenly foliated S 35° W.

High wall of gneiss.

The river flows from the south end of the lake on the west side of a high abrupt wall of gneiss, and shortly afterwards tumbles down a heavy rapid over broken masses of gneiss to quiet water again. The canoe was carried for 300 yards on the east bank, through woods of small poplar and pine, over a soil composed of gray clay or silt, overlying a dark-gray rather irregularly foliated biotite-gneiss.

Last rapid on the river.

The next and last obstruction on this river is three miles lower down, where the water flows in a heavy double rapid with a descent of about twenty-five feet, chiefly over a bed of boulders. The canoe was carried past it for 300 yards on the west bank on a good track over a low hill of soft gray clay or silt. The surrounding country consists chiefly of high barren rocky hills.

Granite highly charged with pyrite.

Two miles lower, the river flows through a narrow rocky gap into the bottom of a deep bay of one of the lake-like expansions of Churchill River. On the west side of this gap is a steep rocky slope, underlain by a rather coarse plagioclase-granite often highly charged with pyrite. The pyrite has commonly been dissolved from the face of the rock, leaving a red or yellow porous mass and giving the whole face of the cliff a very rough spongy appearance. At a low point just outside the gap, a dark-green hornblende-schist lies in very irregular contact with the gneiss, and at an adjoining exposure the schist is irregularly cut by many veins of light red pegmatite. The surface of the rock here is scored by glacial grooves trending S. 35° W.

Foster River had now been descended throughout its whole course from Foster Lakes, a distance of ninety miles, and with a total descent of 400 feet. The journey through the unknown country south of Wollaston Lake had been accomplished, and it remained to return up Churchill River to Ile à la Crosse as quickly as consistent with the necessity of shooting ducks enough to furnish us with food by the way.

Churchill River.

The Churchill River had already been surveyed by Mr. T. Fawcett, D.L.S., and our survey was continued from the mouth of Foster River to a recognisable point on an island in Churchill River, after which our attention was devoted to sketching in additional topography along the line of Mr. Fawcett's survey, and examining the country at the portages, camps, and at any other points where we were obliged to land. End of survey.

After leaving Foster River, the high hills disappear, and the shores become lower and more gently undulating, rising in thickly wooded slopes from the rocky banks.

At the Lower Needle Falls, the water drops about four feet over a band of thinly and evenly foliated greenish-gray fine-grained biotite-gneiss striking S. 25° W. and dipping N. 65° W. at an angle of 80°, interlaminated with some swelling and contracting bands of red granite. The surface of this rock has been weathered into sharp rough points and edges, and on their account, the voyageurs, who were obliged to carry their heavy loads over it with feet bare, or at best protected by soft moccasins, gave it the name of Needle Portage. Lower Needle Falls.

The Middle Needle Falls are over the same thinly foliated gneiss containing a large number of quartz inclusions and associated with a rather fine-grained light reddish-gray quartzite. It is everywhere very much jointed and broken. At the Upper Needle Falls, the rock is a thinly foliated gneiss, irregularly interlaminated with bands of granite. Needle Lake is a considerable body of water extending a long distance south of the line of travel, while deep bays indent its northern shore. A few hills rise here and there, one extending east and another south of the lake, the latter having the appearance of a ridge of sand. The country is more or less generally wooded with small poplar and spruce. The shores towards the east are composed of dark biotite-gneiss, generally dipping at a low angle toward the west, and further westward this rock is replaced by a coarse red granite rising in barren rounded hills. At the west end of the lake Middle Needle Falls. Upper Needle Falls.

the rock is a whitish, red-weathering, granular granite composed of quartz and microcline, in places showing a slight gneissic foliation. The surface is well rounded and smoothed, showing glacial markings trending S. 25° W.

Souris River. Souris or Mouse River, flows into Churchill River in a wide marsh, circling round the north-east end of a high range of hills of red gneiss, striking S. 30° W. Glacial grooves were observed in two places trending respectively S. 43° W. and S. 50° W.

A mile and a-half above the mouth of the river is an old fur-trading outpost, occupied only in winter.

Opposite the mouth of Trout Creek are three small parallel drumlin-like islands composed entirely of sand and boulders.

Souris Lake. Souris Lake is a long stretch of open water, the shores of which are for the most part well wooded with poplar. Occasionally low points of red gneiss may be seen here and there, but the beach is generally of sand and boulders, and most of the low hills that lie back from the shore seem to be of the same composition. Where we turned again into the river the lake continued southward beyond the limit of vision.

Snake Rapid. Snake Rapid, a mile and a-half long, over a bed of boulders, connects Souris and Snake lakes. On its north side is a sandy terrace fifteen feet high, which gradually rises until it seems to merge in a low hill of sand and boulders. On its south side is a low hill, the summit of which is a moderately level plain, covered with Archæan boulders chiefly of local origin. On the portage-track beside this rapid, an Indian living a short distance higher up the river had two large steel bear traps concealed and set, and some one of the party would have almost certainly been seriously injured but for a letter written in Chippewyan syllabic characters and hung on a pole warning everyone to "look out for the bear traps on the portage." Unless our men had been able to read Chippewyan, this letter would have been of little service in warning us of the danger.

Snake Lake. Snake Lake was crossed against a heavy west wind. No rock was seen, the surrounding country being composed of wooded hills of boulders, the highest being the ridge to the south-east of the lake.

A short distance above Snake Lake, the rock again makes its appearance, as a coarse red garnetiferous hornblende-gneiss, striking S. 30° to 35° W., and more or less nearly vertical. Below the mouth of Haultain River, it flows with a strong current through a wide marsh

between long ridges of gneiss. Haultain River, where it flows into the north side of Churchill River, over a shallow bar of sand, is about 300 feet wide. Haultain River.

Lac de Geneau or Knee Lake is a large stretch of fairly open water, bent around a long narrow point extending towards the south-west. This point, and, in fact, most of the shore, consists of low hills covered with a forest of poplar, through which bare rounded points and knobs of gneiss project here and there. Between these points the beach is commonly strewn with boulders. Knee Lake.

The Lower Knee Rapid is a long shallow stretch of water flowing at first over a ledge of moderately coarse red gneiss, and then over a bed of boulders. The north bank is a cliff thirty feet or more in height, of light-gray sandy till, holding a large number of boulders and rising to an even sandy plain or terrace. The Middle and Upper Knee Rapids are around a long point of red gneiss, which becomes grayer and contains more plagioclase on its west side. Knee Rapids.

The shores of Lake Primeau are generally low and composed of reddish gneiss, rising to some rather high hills towards the north. Primeau Lake.

On the east side of Pelican Lake is a low point of reddish-grey gneiss wooded with poplar and willow. The surface is somewhat weathered, but it shows clear glacial grooves running S. 20° W., in which are many typical cross fractures opening southward. Here we heard shooting at the mouth of the river, about four miles distant, and crossing the lake, we came to a large band of Chippewyans on their way from Ile à la Crosse to their hunting grounds in the north on Haultain and Foster rivers. From them provisions were obtained sufficient for the remainder of our journey. Pelican Lake.

Pelican Rapids is a cascade with a descent of about eight feet over a red medium-grained biotite-gneiss, generally almost massive, but in places slightly foliated N. 50° W. The north bank below the fall is a terrace of sand and boulders twenty feet high. Pelican Rapids.

For several miles above Pelican Rapid, the river flows from the north-west with a moderate current, between low sandy banks overhung with willows, beyond which the country is wooded with poplar.

At the lowest Deer Rapid, on the south bank, is a rounded hill of coarse red gneiss striking S. 15° W., and dipping S. 75° E. at an angle of 60°. The surface is smooth, and in many places quite brightly polished, and up the stoss side and on the summit, fine and coarse Deer Rapid.

striæ can be clearly seen running S. 22° W. On a polished surface in a slight hollow on the summit, older striæ run south, but it is not probable that there is much difference in the ages of the two sets. Above this rapid, for half a mile, to the next rapid, the river flows from the south in a trough of this coarse red granitoid gneiss, the sloping rock on each side being beautifully smoothed and grooved all down its side, by the action of the ice-sheet, which moved directly along the axis of the trough.

Last exposure of Archæan rocks on Churchill River.

A short distance above this rapid, a hill of red granite rises on the south bank, being the last outcrop of Archæan rocks seen in the ascent of the Churchill River. A little higher up stream, the mouth of Mudjatic River was passed, and we were again in country that we had passed through nearly three months before.

Our circle of explorations through the country to the north had been completed, and we hurried on and reached Ile à la Crosse on the evening of the 20th September, just as a heavy equinoxial storm set in.

Geological Survey of Canada

GEORGE M. DAWSON, C.M.G., LL.D., F.R.S. &c., DIRECTOR

1897

Geological outlines along Peace and Athabasca Rivers by R. G. McConnell, 1897.

Reported level country doubtless underlain by Athabasca Sandstone.

For geological description of this region see Report on Doobaunt and Kazan Rivers by J. B. Tyrrell.

Legend

- K — Cretaceous
- C — Cambrian (Athabasca Sandstone)
- B — Huronian
- A — Laurentian (Granitoid gneisses)
- A' — Massive Granite Rocks
- Gn. Nor. — Basic Eruptives, Norite, Gabbro, etc
- Glacial Striæ
- 116' — Depth of water and fall in rapids
- 690' — Height above sea
- Por. 5 c. — Portages (length in chains)
- Rap. — Rapids

Eastern Boundary of Athabasca District

Approximate north-eastern boundary of Palæozoic limestone

Height of Land

Legend

K — Cretaceous

C — Cambrian (Upper Athabasca Sandstone)

B — Huronian

A — Laurentian (Granitoid gneisses)

A — Massive Granitic Rocks

Ba. Nor. — Basic Eruptives, Norite, Gabbro, etc

Glacial Striæ

114' — Depths of water and fall in rapids

690' — Height above sea

Por 5c. — Portages (length in chains)

Rap. — Rapids

Geological outlines along Peace & Athabasca Rivers by R. G. McConnell

Reported level country doubtless underlain by Athabasca Sandstone.

MUSKEG HILLS

Eastern Boundary of Athabasca District

Northern Boundary of Saskatchewan District

Height of Land

Approximate north-eastern boundary of Palæozoic limestone

Compiled by D B Dowling, B.Ap.Sc., and C O Sentical, C.E.

Drawn for photo-lithography by C O Sentical.

SOURCES OF INFORMATION

Cree, Mudjatick, Beaver, Geikie, Foster, Peace, and lower part of Cochrane rivers from surveys by J. B. Tyrrell, 1892, '93, '94. Swan, Reindeer, Black and Montreal rivers, Wollaston Lake and south shore of Lake Athabasca, by D. B. Dowling, 1892. North shore of Lake Athabasca and Chipman River by J. W. Tyrrell, 1893. Upper part of Cochrane River by A. S. Cochrane, 1881. Reindeer Lake by A. S. Cochrane, 1880, and D. B. Dowling, 1892. Peace, Slave and Athabasca rivers by W. Ogilvie, 1884. Clearwater and Churchill rivers by T. Fawcett, 1838, with additions by J. B. Tyrrell, 1892.

MAP
of the
COUNTRY BETWEEN LAKE ATHABASCA AND CHURCHILL RIVER

To accompany Report of J Burr Tyrrell, M.A.

Natural Scale — 1:584,000.

Scale, 25 miles to 1 inch.

Accompanying Part D. Annual Report Vol VIII, 1895